

BUESCHER STATE PARK

DAM IMPROVEMENTS PROJECT

TECHNICAL REFERENCE MANUAL

TPWD PROJECT # 118686



HALFF ASSOCIATES, INC.
TBPELS Firm No. 312
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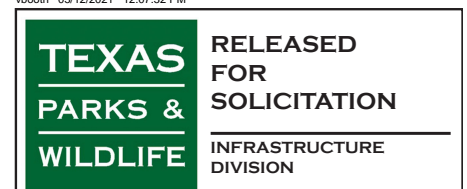


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Special Instructions to Bidders

If there is any discrepancy or confusion with contractual language contained in these technical specifications the contractual provisions and methods within the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC) document will govern this project.

Any reference in the technical specifications to "the Contracting Officer" relates to the TPWD's Owner's Designated Representative (ODR). Submittals will follow the TPWD's regular submittal review process in the UGC. Payment methods referenced in the specifications are superseded by the UGC standard practices.

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.4 INFORMATIONAL SUBMITTALS

Submit the required informational submittals per the TPWD Uniform General Conditions in PDF electronic format:

1. Contractor's initial construction schedule of size required to display entire network for entire construction period.
2. Daily Construction Reports: Submit at a maximum weekly intervals.
3. Monthly reports which include:
 - a. Updated Construction Schedule;
 - b. The work accomplished during the month;
 - c. The percent of the contract time used;
 - d. The percentage of completion of the project on the date of the report;
 - e. A description of problem areas encountered during construction;
 - f. The dates of the reporting period; and
 - g. Any changes in the contact information.
4. Construction test results originated by the Contractor.
Site Conditions Report: Submit at time of discovery of differing conditions.

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.6 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report in accordance with the contract general conditions (UGC).
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- C. Final Record Drawings: The Contractor must maintain construction records during construction which will be used to generate the final Record Drawings.

END OF SECTION 01 32 00

SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs
2. Periodic construction photographs.
3. Final completion construction photographs.
4. Preconstruction video recordings.
5. Periodic construction video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three (3) days of taking photographs.
1. Submit photos on thumb-drive. Include copy of key plan indicating each photograph's location and direction.
 2. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Engineer.
 - d. Name of Contractor
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- C. Video Recordings: Submit video recordings within seven (7) days of recording.

1. Submit video recordings on thumb-drive. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information in file metadata tag:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Date video recording was recorded.
 - f. Description of vantage point, indicating location, and direction by compass point.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of twelve (12) megapixels, and at an image resolution of not less than 3200 by 2400 pixels and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of twelve (12) megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata; Record accurate date and time and GPS location data from camera.
- E. File Names: Name media files with date, project area and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before starting construction, take photographs of Project site, surrounding properties, staging areas, haul roads and access roads, including existing items to remain during construction, from different vantage points, and/or as directed by Engineer.
 1. Flag excavation areas and construction limits before taking construction photographs.
 2. Take at least twenty (20) photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 3. Take at least twenty (20) photographs to show existing conditions adjacent to property before starting the Work.
 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take at least twenty (20) photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

- E. Final Completion Construction Photographs: Take at least fifty (50) photographs after date of Substantial Completion for submission as Project Record Documents.
- F. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Immediate follow-up when on-site events result in construction damage or losses.
 - b. Substantial Completion of a major phase or component of the Work.
 - c. Extra record photographs at time of final acceptance.

1.5 CONSTRUCTION VIDEO RECORDINGS

- A. Video Recording Photographs: Engineer may request photographs in addition to periodic photographs specified.
- B. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, and direction by compass point.
 - 1. Confirm date and time at beginning and end of recording.
 - 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
- C. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, and/or as directed by Engineer.
 - 1. Flag excavation areas and construction limits before recording construction video recordings.
 - 2. Show existing conditions adjacent to Project site before starting the Work.
 - 3. Show existing buildings or structures either on or adjoining Project site to accurately record physical conditions at the start of construction.
 - 4. Show protection efforts by Contractor.

END OF SECTION 01 32 33

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
- 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
- 2. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
- 3. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer and Construction Manager's responsive action. TPWD approval is required for submittals with a "TPWD" designation.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer and Construction Manager's responsive action. Submittals not having a "TPWD" designation are for Contractor Quality Control approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Engineer and Construction Manager's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include a cover sheet with the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Engineer.
 4. Name of Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.
 7. Names of subcontractor, manufacturer, and supplier.
 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 9. Category and type of submittal.
 10. Submittal purpose and description.
 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 12. Drawing number and detail references, as appropriate.
 13. Indication of full or partial submittal.

14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

- B. Options: Identify options requiring selection by Engineer.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Paper Submittals: No Paper submittals will be accepted.
- E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 1. Email: Prepare submittals as PDF package, and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.
 - a. Engineer through Construction Manager will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow **15** days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow **15** days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Engineer consultants, Owner, or other parties is indicated, allow **21** days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Engineer action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Operational range diagrams.
 - b. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - c. Operation and Maintenance Requirements.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

- a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. PDF paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least **8-1/2 by 11 inches, but no larger than 22 by 34 inches.**
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Construction Manager will return submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

- a. Number of Samples: Submit **three** sets of Samples. Construction Manager will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 - 2. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 - 3. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 - 4. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 - 5. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
 - 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product.
 - 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer and Construction Manager.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Engineer and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ENGINEER AND CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals: Engineer and Construction Manager will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Engineer and Construction Manager will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Construction Manager will review each submittal and will return it if it does not comply with requirements.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer and Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Engineer and Construction Manager will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Engineer without action.

END OF SECTION 01 33 00

SECTION 01 40 00

QUALITY REQUIREMENTS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of **five** previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.
- 1.4 DELEGATED DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
 2. Design professional shall be licensed in the State of Texas.
- B. Delegated Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified

by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1. Design professional shall be licensed in the State of Texas.

1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.

13. Recommendations on retesting and reinspecting.

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Statement that products at Project site comply with requirements.
 - 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Statement that equipment complies with requirements.
 - 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 3. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329 and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups of size indicated.
 - 2. Build mockups in location indicated or, if not indicated, as directed by Engineer or Construction Manager.
 - 3. Notify Engineer and Construction Manager **seven** days in advance of dates and times when mockups will be constructed.
 - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
 - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 6. Obtain Engineer's and Construction Manager's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow **seven** days for initial review and each re-review of each mockup.
 - 7. Promptly correct unsatisfactory conditions noted by Engineer's preliminary review, to the satisfaction of the Engineer, before completion of final mockup.
 - 8. Approval of mockups by the Engineer does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 - 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 10. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 1. Notify testing agencies at least **24** hours in advance of time when Work that requires testing or inspection will be performed.

2. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 3. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 4. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspection equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's, Construction Manager's and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner, Engineer, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: **Pay** sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: **Pay** water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: **Pay** electric-power-service use charges for electricity used by all entities for construction operations.

1.4 SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Traffic Control Plan: Show temporary traffic control to address interim construction sequencing, contractors means and methods and all issues not covered in the plans.

- C. Forestry Plan: Prior to the start of work, submit a plan showing the locations for tree trimming and removal. Tree removal and protection plan shall include all locations detailed in the construction site plan including but not limited to temporary facilities (equipment and material storage area (onsite and offsite)), access and haul routes, and construction site. Show locations of tree protection temporary fences, limits of trimming and quantity (including species) of removal. Tree removal and protection plan shall be in accordance with the plans. Any tree identified for removal on the tree removal plan shall be marked (nail and visible flagging) a minimum of 5 days prior to removal.
- D. Natural Resources Protection Plan: Show location and type of temporary measures to be maintained during construction
- E. Historical Area Protection Plan: Show location and type of temporary measures to be maintained during construction
- F. Temporary Culvert Shoring and Protection Plan: Show location and type of temporary measures to be maintained during construction to protect Historic CCC culverts from construction loading.

The Contractor's plans for temporary culvert shoring and protection shall be submitted to the Engineer prior to the start of construction operations and be sign and sealed by a Texas Licensed Professional Engineer.

- G. Storm Water Pollution Prevention Plan (SWPPP): The contractor shall comply with all the requirements of the TCEQ TPDES General Permit No. TXR150000. The information contained within the plans are not a SWPPP plan. Show all applicable items: offsite borrow and fill areas, areas disturbed, concrete batch plants, storage areas, on site waste and trash storage, fueling area, concrete truck washout location(s), construction phasing.
- H. Removal of Water Plan: Written plans for diverting surface waters and for dewatering the site are required. Written plans for protection of the new principal spillway installation from reservoir water are required. The means of protection shall be designed, complete with plans, and sealed by a Professional Engineer licensed in Texas.

The Contractor's plans for diverting surface waters and dewatering the site shall be submitted to the Engineer prior to the start of construction operations.

- I. Implementation and Termination Schedule: Within **15** days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- J. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch OD line posts and 2-

7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide **galvanized-steel** bases for supporting posts.

- C. Construction Fencing: The fence shall be high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 48-inches high and maximum mesh size of 2-inches, supported and tightly secured to steel post located on a maximum of 8-foot centers.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

PART 3 - EXECUTION

3.1 LIMITS OF CONSTRUCTION

- A. Mark the limit of construction areas beyond that shall not be disturbed under this Contract by construction activities. Mark or fence isolated areas within the general work area that are not to be disturbed. Protect site elements and survey monuments as indicated on the plan before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. Personnel must be knowledgeable of the purpose for marking and protecting particular areas.

3.2 HAUL ROADS, GENERAL

- A. Construct access and haul roads necessary for proper prosecution of the work under this contract. Construct with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic are to be avoided. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations.

- B. Plans and specifications do not identify Means & Methods of executing temporary access. Access to the site is by Contractors Mean & Methods, Technique, sequences and procedures incidental to the project.

3.3 TRAFFIC PROVISIONS

A. Maintenance of Traffic

1. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the MUTCD, Part VI. Make all notifications and obtain any permits required for modification to traffic movements outside TPWD facilities. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.
2. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.
3. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

B. Protection of Traffic

1. Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit.
2. Contractor is responsible for the repair of any damage to roads caused by construction operations. Contractor shall repair existing road full width and depth, minimum length 25-feet as measured along the centerline of the road.
 - a. Saw cut existing asphalt pavement at limits of repair.
 - b. Prepare subgrade and install subbase and base for pavement repair areas according to Section 31 20 00 "Earthwork."
 - c. Recondition base including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - d. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 32 12 16 "Bituminous Concrete Pavement."

3.4 REMOVAL OF WATER, GENERAL

- A. The work consists of the removal of surface water and ground water as necessary to perform the construction required by the contract in accordance with the specifications. It shall include:
 - 1. constructing, installing, building, and maintaining all necessary temporary water containment facilities, channels, and diversions;
 - 2. furnishing, installing, and operating all necessary pumps, piping, and other facilities and equipment; and
 - 3. removing all such temporary works and equipment after their intended function is no longer required.
- B. Diverting Surface Water
 - 1. The contractor shall install, maintain, and operate all cofferdams, channels, flumes, sumps, and all other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site. Control of surface water shall be continuous during the period that damage to construction work could occur. Unless otherwise specified and/or approved, the diversion outlet shall be into the same drainageway that the water would have reached before being diverted.
 - a. Additional dewatering capacity to draw the water level down to this level within 24 hours days shall be provided in the event of flooding
- C. Dewatering the Construction Site
 - 1. Foundations, cutoff trenches, and all other parts of the construction site shall be dewatered and kept free of standing water and muddy conditions as necessary for the proper execution of the work. The contractor shall furnish, install, operate, and maintain all drains, sumps, pumps, casings, well points, and all other equipment required to properly dewater the site as specified. Dewatering systems that cause a loss of soil fines from the foundation areas will not be permitted.
 - a. Excavation for the installation of the RCC chute and concrete outlet structure shall be kept free of water during placement of concrete and backfilling. The water table at a concrete structure location shall be kept 3 feet below the subgrade of the concrete during and for a minimum of seven days after concrete placement. The water table at a backfill location shall be maintained a minimum of 2 feet below the backfill surface.

3.5 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.6 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.7 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install land-based telephone line(s) for each field office.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Engineer's office.
 - f. **Construction Manager's home office.**
 - g. Engineers' offices.
 - h. Owner's office.
 - i. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Engineer and Owner to access Project electronic documents and maintain electronic communications.

3.8 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area that is noncombustible according to ASTM E136. Comply with NFPA 241.
 - 2. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 32000 "Exterior Improvements."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."
- D. Parking: **Use designated areas of Owner's existing** parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

3.9 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Comply with TCEQ TPDES General Permit No. TXR150000 requirements.
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties according to TCEQ TPDES General Permit No. TXR150000 requirements.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- G. Site Enclosure Fence: **Before construction operations begin**, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: Limits of Construction as indicated on Drawings.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

3.10 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 56 39

TEMPORARY TREE AND PLANT PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at 6 inches above the ground for trees up to, and including, 4-inch size; and 12 inches above the ground for trees larger than 4-inch size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, as indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.0 times the diameter of the drip line, within a minimum of 5 feet clearance barrier between drip line and fence, unless otherwise indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified tree service firm.
- B. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements. Previously used materials may be used when approved by Owner or Engineer.

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet apart.
 - a. Height: 4 feet.
 - b. Color: High-visibility orange, nonfading.
- B. Plywood Wood for Protection Zone vehicle Crossings:
 1. $\frac{3}{4}$ inch thick, exterior grade plywood veneer sheathing.
- C. Trunk Protection (Planking) Wood:
 1. 2 X 4-inch or 2 X 6-inch planking or plastic strapping and shall be attached in a manner that does not damage the tree.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Tie a 1-inch blue-vinyl tape around each tree trunk at 54 inches above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.2 TREE AND PLANT-PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Owner and Engineer.
 2. Post to be set in vertical plumb position with top of posts aligning with adjacent post where grades allow. Fence to be kept tight and neat.
- B. Maintain protection zones free of weeds and trash.
- C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Engineer and in accordance to the General Notes.
- D. Maintain protection-zone fencing in good condition as acceptable to Consultant and remove when construction operations are complete and equipment has been removed from the site.
 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
- E. Vehicle Crossing of Protection Zone:
 1. Plywood shall be laid down over root zone to distribute weight of construction vehicle.

3.3 EXCAVATION

- A. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered

immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

- B. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.4 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots by hand as directed by the Owner and as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, ears, or pulls roots.
 - 2. Cut Ends: Coat cut ends of roots with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to Owner.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.
 - 5. Backfill as soon as possible.
- B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.5 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction and as approved by the Owner. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period.
 - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
- B. Chip removed branches and dispose of off-site.

3.6 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.
 - 1. Treat damaged trunks, limbs, and roots.
 - 2. Perform repairs within 24 hours.
 - 3. Replace vegetation that cannot be repaired and restored to full-growth status in accordance with the General Notes.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 01 56 39

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

The work consists of implementing the storm water pollution prevention measures to prevent sediment from entering streams or water bodies as specified in this Section in conformance with the requirements of the Texas Pollutant Discharge Elimination System (TPDES).

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

(1992) Storm Water Management for Construction Activities Developing Pollution Preventions and Plans and Best Management Practices

1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required of the Contractor are described below.

1.4.1 Stabilization Practices

The stabilization practices to be implemented include geotextiles, erosion control mats, protection of trees, preservation of mature vegetation, etc. On the daily Report, record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, initiate stabilization practices as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have temporarily or permanently ceased.

1.4.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases or is precluded by unsuitable conditions caused by the weather, initiate stabilization practices as soon as practicable after conditions become suitable.

1.4.1.2 No Activity for Less Than 21 Days

When the total time period in which construction activity is temporarily ceased on a portion of the site is 21 days minimum, stabilization practices do not have to be initiated on that portion of the site until 14 days have elapsed after construction activity temporarily ceased.

1.4.1.3 Burnoff

Burnoff of the ground cover is not permitted.

1.4.1.4 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified, and protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

1.4.2 Erosion, Sediment and Stormwater Control

- a. Stabilized Construction Entrance/Exits
- b. Temporary Sediment Control Fence
- c. Rock Berm Filter Dam
- d. Mulch Sock/Fiber Roll
- e. Storm Water Notice of Intent for Construction Activities
- f. Submit a Storm Water Notice of Intent for TPDES coverage under the general permit for construction activities and a Storm Water Pollution Prevention Plan (SWPPP) for the project to the TPWD's Owner's Designated Representative (ODR) prior to the commencement of work. The SWPPP shall meet the requirements of the State of Texas general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intent, Notice of Termination, and appropriate permit fees, via the TPWD's ODR, to the appropriate State agency for approval, a minimum of 14 calendar days prior to the start of any land disturbing activities. Maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, to reflect current site conditions. Include within the SWPPP:
 - 1) Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.
 - 2) Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the site.
 - 3) Ensure compliance with terms of the State of Texas general permit for storm water discharge.
 - 4) Select applicable best management practices from Texas Commission on Environmental Quality, Erosion Control BMPs.

- 5) Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.
- 6) Storm Water Pollution Prevention Measures and Notice of Intent 40 CFR 122.26, EPA 832-R-92-005. Provide a "Storm Water Pollution Prevention Plan" (SWPPP) for the project. The SWPPP will meet the requirements of the State of Texas general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intent, Notice of Termination, and appropriate permit fees, via the TPWD's ODR, to the appropriate State agency for approval, a minimum of 14 calendar days prior to the start of construction. A copy of the approved SWPPP will be kept at the construction on-site office, and continually updated as regulations require to reflect current site conditions.

1.4.3 Stormwater Drainage

There will be no direct discharge of excavation ground water to the sanitary sewer, storm drains, or to the river. Discharge of hazardous substances will not be permitted under any circumstances. Provide erosion protection of the surrounding soils.

1.4.4 Structural Practices

Implement structural practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement structural practices in a timely manner, during the construction process, to minimize erosion and sediment runoff. Location and details of installation and construction are shown on the drawings.

1.4.5 Vegetation

- a. Provide temporary protection on slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.
- b. Provide new seeding where ground is disturbed. Include topsoil or nutrient during the seeding operation necessary to establish a suitable stand of grass, unless otherwise noted on the plans. Seeding shall comply with the requirements of Section 32 92 19 SEEDING.

1.5 WATERS OF THE UNITED STATES

Do not enter, disturb, destroy, or allow discharge of contaminants into waters of the United States except as authorized herein. The protection of waters of the United States shown on the drawings in accordance with paragraph LICENSES AND PERMITS is the Contractor's responsibility. Authorization to enter specific waters of the United States identified does not relieve the Contractor from any obligation to protect other waters of the United States within, adjacent to, or in the vicinity of the construction site and associated boundaries.

1.5.1 LICENCES AND PERMITS

Proposed construction activities are under the jurisdiction of the U.S. Army Corps of Engineers' LOP-1. See contract book for a copy of the permit and contractor responsibilities under the permit.

1.6 SUBMITTALS

Submittals will be handled in accordance with the TPWD UGC.

SUBMITTAL PROCEDURES:

Preconstruction Submittals

Storm Water Pollution Prevention Plan Storm Water Notice of Intent (NOI)

Approved Storm Water Pollution Prevention Plan (SWPPP)

Test Reports

Storm Water Inspection Reports for General Permit
Erosion and Sediment Controls

PART 2 - PRODUCTS

2.1 Refer to construction plans for details and information regarding recommended temporary erosion control procedures

2.2 STABILIZED CONSTRUCTION ENTRANCE/EXIT Provide materials that meet the details shown on the plans and this Section.

- a. Rock Construction Exit. Provide crushed aggregate for long and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft, or flaky materials and organic and injurious matter. Use 4 to 8 in. open graded aggregate for Type 1 and 2- to 4-in. aggregate for Type 3.
- b. Timber Construction Exit. Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot. Fasten timbers with nuts and bolts or lag bolts, of at least 1/2 in. diameter, unless otherwise shown on the plans or allowed.
- c. Foundation Course. Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed. Details provided are typical and standard. Foundation course thickness shown on plans is a minimum section. Contractor's means and methods dictate equipment to be used. Contractor is responsible for ensuring foundation course is sufficient for anticipated equipment loading.

2.3 TEMPORARY SEDIMENT CONTROL FENCE (Toad Exclusion Fence) Provide a net-reinforced fence using woven geo-textile fabric. Logos visible to the traveling public will not be allowed. Toad Exclusion Fence detail shown in plans are intended to serve dual purpose and shall be used as Sediment Control Fence.

- a. **Fabric.** Provide fabric materials in accordance with TXDOT DMS 6230, "Temporary Sediment Control Fence Fabric."
- b. **Posts.** Provide essentially straight steel posts with a minimum length of 48 in., unless otherwise shown on the plans. T or L shaped steel posts must have a minimum weight of 1.3 lb. per foot. All post shall be capped with safety caps.
- c. **Net Reinforcement.** Provide net reinforcement of at least 12 1/2 gauge galvanized welded wire mesh, with a maximum opening size of 2 x 4 in., at least 24 in. wide, unless otherwise shown on the plans.
- d. **Staples.** Provide staples with a crown at least 3/4 in. wide and legs 1/2 in. long.
- e. **Used Materials.** Use recycled material meeting the applicable requirements if accepted by the

Engineer.

2.4 ROCK BERM FILTER DAM – TYPE 2

- a. **Aggregate.** Furnish Aggregate with hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding acceptable to Engineer. Use 3 to 6 inch aggregate.
- b. **Wire.** Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:
 - double-twisted, hexagonal weave with a nominal mesh opening of 2 1/2 in. x 3 1/4 in.;
 - minimum 0.0866 in. steel wire for netting;
 - minimum 0.1063 in. steel wire for selvages and corners; and minimum 0.0866 in. for binding or tie wire.
- c. **Sand Bag Material.** Furnish sandbags meeting Section 506.2.I, “Sandbags,” except that any gradation of aggregate may be used to fill the sandbags.

2.5 MULCH SOCK/EROSION CONTROL LOG

- a. Mulching material can be manufactured on or off the project site and may consist of:
 1. Shredded bark
 2. Stump grindings
 3. Composted bark
- b. The mulch shall have the following composition:
 1. Wood chips shall be produced from a 3-inch minus screening process (equivalent to TxDOT item 161, Compost, Section 1.6.2.B Wood Chip Requirements).
 2. Large portions of silts, clays, or fine sands are not acceptable.
 3. The pH of the mulch shall be between 5.5 and 8.5.
 4. The organic matter content shall be greater than or equal to 25% on a dry weight basis.
- c. Mulch material must be free of refuse, physical contaminants, and material toxic to plant growth. It is not acceptable for the mulch material to contain ground construction debris, biosolids, manure, or recyclable material.
- d. Prior to placement, a representative sample of the mulching material must be tested and certified accepted by the TPWD ODR.
- e. “Sock” material will be 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material. The material mesh opening should be equal to or less than 3/8 inch (10 mm) and the material tensile strength should be equal to or greater than 44 psi (3.09 kg/cm²).

PART 3 - EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitats. Prior to the commencement of activities, consult with the TPWD ODR, regarding rare species or sensitive habitats that need to be protected. The protection of rare, threatened, and endangered animal and plant species identified, including their habitats, is the Contractor's responsibility. The following species are known and could be affected within the construction area: Houston Toad.

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work that is consistent with the requirements of the U.S. Army Corps of Engineers' LOP 1. Confine construction activities to within the limits of the work indicated or specified.

Limit permanent disturbance within ordinary high water marks shown on the plans to the grading and permanent structures shown on the plans. Temporary disturbance within ordinary high water marks shall be shown on the Construction Site plan and approved by the Engineer and/or USACE.

3.1.1 Flow Ways

Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as specified and permitted.

3.1.2 Streams

Stream crossings must allow movement of materials or equipment without violating water pollution control standards of the federal, state, and local governments. Construction of stream crossing structures must be in compliance with any required permits including, but not limited to, Clean Water Act Section 404, and Section 401 Water Quality. The TPWD ODR's approval and appropriate permits are required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Obtain TPWD ODR's approval prior to installation. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition unless otherwise required by the TPWD ODR.

3.2 FIELD QUALITY CONTROL

Maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. Use the following procedures to maintain the protective measures.

3.3 INSPECTIONS

3.3.1 General

Inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Conduct inspections at least once every month where sites have been finally stabilized.

3.3.2 Inspections Details

Inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system. Observe erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan to ensure that they are operating correctly. Inspect discharge locations or points to ascertain whether erosion control measures are effective in

preventing significant impacts to receiving waters. Inspect locations where vehicles exit the site for evidence of offsite sediment tracking.

3.3.3 Inspection Reports

For each inspection conducted, prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. Furnish the report to the TPWD's ODR within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

3.4 STABILIZED CONSTRUCTION ENTRANCE/EXIT

When tracking conditions exist, prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction exits. Construct exits for either long or short-term use.

- a. Long-Term. Place the exit over a foundation course, if necessary. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the plans or as directed. Construct exits with a width of at least 14 ft. for one-way and 20 ft. for two-way traffic for the full width of the exit, or as directed.
 1. Type 1. Construct to a depth of at least 8 in. using crushed aggregate as shown on the plans or as directed.
 2. Type 2. Construct using railroad ties and timbers as shown on the plans or as directed.
- b. Short-Term.
 1. Type 3. Construct using crushed aggregate. This type of exit may be used for daily operations where long-term exits are not practical.
 2. Type 4. Construct as shown on the plans or as directed.

3.5 TEMPORARY SEDIMENT CONTROL FENCE

Provide temporary sediment-control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the fence into erosion-control measures used to control sediment in areas of higher flow. Install the fence as shown on the plans, as specified in this Section, or as directed.

- a. Installation of Posts. Embed posts at least 12 in. deep, or adequately anchor, if in rock, with a spacing of 6 to 8 ft. and install on a slight angle toward the run-off source.
- b. Fabric Anchoring. Dig trenches along the uphill side of the fence to anchor 6 to 8 in. of fabric. Provide a minimum trench cross-section of 6 x 6 in. Place the fabric against the side of the trench and align approximately 2 in of fabric along the bottom in the upstream direction. Backfill the trench, then hand-tamp.
- c. Fabric and Net Reinforcement Attachment. Unless otherwise shown under the plans, attach the reinforcement to steel posts with T clips, in at least 4 places equally spaced. Sewn vertical pockets may be used to attached reinforcement to end posts. Fasten the fabric to the top strand of reinforcement by hog rings or cord every 15 in. or less.
- d. Fabric and Net Splices. Locate splices at a fence post with a minimum lap of 6 in. attached in at least 6 places equally spaced, unless otherwise shown under the plans. Do not locate splices in concentrated flow areas.
- e. Requirements for installation of used temporary sediment-control fence include the following:
 - i. fabric with minimal or no visible signs of biodegradation (weak fibers),
 - ii. fabric without excessive patching (more than 1 patch every 15 to 20 ft.),
 - iii. posts without bends, and
 - iv. backing without holes.

3.6 ROCK BERM FILTER DAM

- a. Rock Berm Filter Dam shall be Reinforced
- b. Height. At least 18 in. measured vertically from existing ground to top of filter dam.
- c. Top Width. At least 2 ft
- d. Slopes. At most 2:1

3.6 MULCH SOCK/FIBER ROLL

- a. Use 12 or 18 inch diameter mulch socks for all sediment control applications. This diameter of mulch sock material has proven to be the most consistent for all sediment control applications.
- b. Install mulch socks as shown on the plans or as directed.
- c. Mulch socks should be used at the base of slopes no steeper than 2:1
- d. Place mulch socks at a 5 ft or greater distance away from the toe of the slopes to maximize space available for sediment deposition.
- e. When placed on level contours, sheet flow of water should be perpendicular to the mulch sock at impact and unconcentrated. Install mulch socks using rebar (#5 minimum with safety caps) a minimum of 48 inches in length placed on 2-ft centers. In order to prevent the movement or floating of the mulch sock during rain events or construction operations, install steel posts on alternating sides of the sock. Drive the posts into the ground to a minimum depth of 24 inches, leaving less than 12 inches of post above the exposed mulch sock.
- f. In order to prevent water flowing around the ends of the mulch socks, point the ends of the socks up slope.
- g. In order to prevent water from flowing between the gaps at adjacent ends of mulch socks, overlap the ends of adjacent mulch socks a minimum of 24 inches. Never stack mulch socks on top of one another.
- h. Mulch Socks should be placed using 'smiles' and 'j-hooks'.
- i. For steeper slopes, an additional mulch sock can be constructed on the top of the slope and within the slope area as shown on the plans or determined by specific field conditions. Multiple mulch socks are recommended on steeper slopes.
- j. Do not use mulch socks in areas of concentrated flow as they are intended to control sheet flow only.

END OF SECTION 01 57 23

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 02 42 91 "Removal and Salvage of Historic Construction Materials"
 - 2. Section 31 10 00 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of proposed methods to provide handling, containers, storage, signage, transportation, and other items as required to implement waste management.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Document existing condition of Salvaged items.
 - 2. Store items in a secure area until installation.
 - 3. Protect items from damage during transport and storage.
 - 4. Install salvaged items to existing or better condition.

- B. Salvaged Items for Owner's Use:
 - 1. Store items in a secure area until delivery to Owner.
 - 2. Transport items to Owner's storage area designated by Owner.
 - 3. Protect items from damage during transport and storage.

3.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.

END OF SECTION 01 74 19

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.3 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

1. Refer to TPWD UGC Article 12 for Substantial completion procedures.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 1. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 3. Submit final completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer **and Construction Manager** will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order.
 2. Organize items applying to each space by major element.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer **and Construction Manager**.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Engineer, **through Construction Manager**, will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit **on digital media acceptable to Engineer.**
- D. Warranties in Paper Form:
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch** paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove debris from limited access spaces, manholes, and similar spaces.
 - f. Remove labels that are not permanent.
 - g. Leave Project clean and ready for occupancy.

- B. Construction Waste Disposal: Comply with waste disposal requirements in **Section 01 50 00 "Temporary Facilities and Controls"** and **Section 01 74 19 "Construction Waste management and Disposal"**.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 01 77 00

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Requirements:

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 1) Submit PDF electronic files of scanned record prints and **one** set(s) of file prints.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned Record Prints and one set(s) of file prints.
- B. Record Specifications: Submit **annotated PDF electronic files and one bound paper copy** of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit **annotated PDF electronic files and directories and one bound paper copy** of each submittal.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer **and Construction Manager**. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Engineer for resolution.
 4. Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect **and Construction Manager**.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
- B. Format: Submit record specifications as **annotated PDF electronic file and one bound paper copy**.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders and Record Drawings where applicable.
- C. Format: Submit Record Product Data as **annotated PDF electronic file and one bound paper copy**.
 - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's **and Construction Manager's** reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

Section 02 41 00

Demolition & Deconstruction

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Removal and disposal of designated foundations, walls, concrete, utilities, mechanical, lighting and other structures.

1.3 QUALITY ASSURANCE

- A. Contractor Qualifications: Minimum of 5 years experience in demolition of comparable structures.
- B. Requirements of Regulatory Agencies:
 - 1. Comply with requirements of codes.
 - 2. Comply with requirements of local Public Health Authority.
 - 3. Comply with local utility companies and/or utility districts.

1.4 SUBMITTALS

- A. Certificates of severance of utility services.
- B. Permit for transport and disposal of debris.
- C. Demolition procedures and operational sequence for review by Owner's Representative

1.5 JOB CONDITIONS

- A. Protection:
 - 1. Erect barriers, fences, guard rails, enclosures, chutes, and shoring to protect structures, and utilities remaining intact.
 - 2. Protect designated trees and plants from damage.
- B. Maintaining Traffic:
 - 1. Ensure minimum interference with roads, street, driveways, sidewalks, and adjacent facilities.
 - 2. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
 - 3. If required by governing authorities, provide alternate routes around closed or obstructed traffic ways.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Prepare adjacent areas to prevent injury, movement or settlement of structures which are to remain.
- B. Arrange for and verify termination of utility services to include removing meters and capping lines.
- C. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- D. Remove items scheduled to be salvaged for Owner, and place in designated storage area.

3.2 DEMOLITION

- A. Remove designated foundations, walls, concrete, utilities, mechanical, lighting & other structures and dispose of as follows:
 - 1. Dispose of items which are not more than two feet below subgrade elevation.
 - 2. Break items more than two feet below subgrade elevation into sizes not to exceed twelve inches in maximum dimension and leave in place, unless it interferes with succeeding items of construction.
 - 3. Stockpile ballast, gravel other pavement materials when required.
- B. Coordinate removal and relocation of power poles, street lighting, telephone lines and site lighting, with the local electric utility.
- C. Remove existing water services, sanitary sewer and storm drainage pipe and structures as indicated and as necessary to facilitate new construction.
- D. Remove old foundations, cisterns, etc., which may be encountered within the building area.

3.3 SELECTIVE STRUCTURAL DEMOLITION

- A. General:
 - 1. Prior to the start of demolition, carefully study the drawings and these Specifications.
 - 2. In company with the Owner or the Owner's representative, visit the site and verify the extent of demolition to be performed under this contract.
- B. Observe all safety and health precautions as required for removal of hazardous materials when hazardous materials are identified as part of the demolition activity. Refer to specific work requirements associated with hazardous material removal.
- C. Protect other components, materials and landscaping in the vicinity of the demolition to prevent unintentional damage to components and materials that are not to be removed. Provide temporary support of structures that are to remain that are affected by the materials to be demolished and removed.
- D. Remove materials as designated on the drawings. Salvage existing native sandstone (brown stone) to the extent reasonably feasible for use in performing the Work.
- E. Demolished materials that are not to be salvaged for reuse on this project shall be considered to be the property of the contractor and shall be completely removed from the jobsite and disposed of properly.
- F. The contractor shall be responsible for repair of all components, materials and landscaping damaged as part of the demolition process at no additional cost to the Owner.

3.4 DEBRIS REMOVAL

- A. Promptly remove demolition debris from site.
- B. Obtain permission from applicable regulatory authority for disposal of debris to waste disposal site.
- C. Do not store or burn materials on site.

END OF SECTION 02 41 00

SECTION 02 42 91

REMOVAL AND SALVAGE OF HISTORIC CONSTRUCTION MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICES

- A. Native Sandstone Rubble

Unit of Measure: No separate pay, subsidiary to other pay items.

- B. Historic Native Sandstone retaining wall east of existing spillway

Unit of Measure: No separate pay, subsidiary to other pay items.

- C. Canoe Shed

Payment for existing condition documentation, shop drawings, deconstruction, salvaging, protection, storage, reconstruction and replacement elements as deemed necessary by TPWD ODR shall be included in the payment for the Canoe Shed removal, salvaging and reconstruction.

Unit of Measure: Per Schedule of Values

1.3 SUMMARY

The work includes removal and salvage of identified historic items and materials, and removal of resulting rubbish and debris. General demolition of non-historic materials and removal of resulting rubbish and debris shall comply with the requirements of Section 02 41 00 DEMOLITION AND DECONSTRUCTION. Materials to be salvaged or recycled shall be stored daily in areas and manner specified by the Contracting Officer. In the interest of conservation, salvage and recycling shall be pursued to the maximum extent possible. Submit a Work Plan describing the procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged or recycled, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

1.3.1 Protection

A. Protection of Existing Historic Property

1. Before beginning any removal, salvage or demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damage to existing historic items that are to remain in place, to be reused, or to remain the property of the TPWD. Repair or restore items damaged by the Contractor to original condition, or replaced, as approved by the TPWD ODR. Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing and supports, as required. Ensure that structural elements are not overloaded and shall provide additional supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.
2. Executing work adjacent to existing historic property indicated in the plans or otherwise identified in the field shall be accomplished with land labor and/or small equipment to the maximum extent possible.
3. Plans call for some specific measures to protect certain existing historic elements. Contractor may propose alternative methods to be reviewed and approved by engineer and TPWD ODR.

1.4 SUBMITTALS

Submittals will be handled in accordance with the TPWD UGC.

Submittals: Salvage Work Plan, Canoe Shed shop drawings

1.5 QUALIFICATIONS

Provide qualified workers trained and experienced in removal and salvage of historic materials.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SALVAGED ITEMS

Salvage items to the maximum extent possible. Prior to any demolition work, historic items to be salvaged shall be removed from the site. Removal of salvageable items shall be accomplished by hand labor to the maximum extent possible. Care shall be taken to not damage historic portions of the structure to remain or items identified for salvage. Furnishings, equipment, and materials not scheduled for salvage or recycling shall be removed prior to any salvaging procedures. Keep a complete recording of all salvaged materials including the condition of such materials before, and after, salvage operations.

3.1.1 Masonry

A. The following masonry items shall be removed and salvaged:

1. Native Sandstone (Brown Stone) Rubble 1-FT or greater in diameter (not specifically shown on the plans). Salvaged sandstone may be incorporated back into the work as approved by TPWD ODR.
2. Historic Native Sand Stone Retaining Wall East of Existing Spillway. Salvaged retaining wall material to be incorporated into the work as shown in the plans.

3.1.2 Timber Structure

A. The following timber structure shall be carefully removed, salvaged and re-constructed:

1. Canoe shed
 - a. Contractor shall document existing condition prior to deconstruction.
 - b. Contractor shall create shop drawing of shed construction prior to deconstruction to facilitate reconstruction.
 - c. Contractor shall replace structure elements as necessary to return shed to existing or better condition upon reconstruction. Replacement elements include but are not limited to support post sunk into subgrade, rotten siding panels not suitable for re-installation and other items damaged during deconstruction.

3.2.1 Items Salvaged for the TPWD

Salvaged items to remain the property of the TPWD shall be removed in a manner to prevent damage, or as directed by the TPWD ODR. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents. In the event TPWD elects to relinquish ownership of salvaged items, the material shall be removed by the contractor at no additional cost to the department.

3.3 CLEAN-UP

Upon completion of the work, adjacent areas and structures shall be cleaned of debris caused by salvage and demolition operations. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

End of Section 02 42 91

SECTION 03 11 13

STRUCTURAL CAST-IN-PLACE CONCRETE FORMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)	
ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	(2016) Specifications for Structural Concrete
ACI 347	(2014; Errata 1 2017) Guide to Formwork for Concrete
ASTM INTERNATIONAL (ASTM)	
ASTM C578	(2018) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

1.3 SUBMITTALS

TPWD approval is required for submittals with a "TPWD" designation; submittals not having a "TPWD" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Formwork; TPWD
Form Removal Schedule; TPWD
SD-03 Product Data
Form Materials

SD-04 Samples

Sample Panels; TPWD

SD-05 Design Data

Calculations

SD-06 Test Reports Inspection

1.4 QUALITY ASSURANCE

Provide Sample Panels of sufficient size to contain joints and not less than long and wide 6 feet long and 4 feet wide. The panels shall be of typical wall thickness and constructed containing the full allocation of reinforcing steel that will be used in the structure, with the forming system that duplicates in every detail the one that will be used in construction of the structure. Use the same concrete mixture proportion and materials, the same placement techniques and equipment, and the same finishing techniques and timing that are planned for the structure. Construction of a finish SF-3.0 will not be permitted until sample panels have been approved. Protect sample panels from construction operations in a manner to protect approved finish, and are not to be removed until all surface finish SF-3.0 concrete has been accepted. After shop drawings have been reviewed, submit sample panels for a surface finish SF-3.0 with applied architectural treatment; build panels on the project site where directed.

1.5 DELIVERY, STORAGE, AND HANDLING

Store fiber voids above ground level in a dry location. Keep fiber voids dry until installed and overlaid with concrete.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

The design, engineering, and construction of the formwork is the responsibility of the Contractor. Design formwork in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses, and capable of withstanding the pressures resulting from placement and vibration of concrete. Comply with the tolerances specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, paragraph CONSTRUCTION TOLERANCES. However, for surfaces with an ACI Class A surface designation, limit the allowable deflection for facing material between studs, for studs between walers and walers between bracing to 0.0025 times the span. Design the formwork as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. Monitor the adequacy of formwork design and construction prior to and during concrete placement as part of the Contractor's approved Quality Control Plan. Submit design analysis and calculations for form design and methodology used in the design. Submit at least 14 days either before fabrication on site or before delivery of prefabricated forms.]

2.2 FORM MATERIALS

Submit manufacturer's data, including literature describing form materials, accessories, and form releasing agents.

2.2.1 Formwork

Comply with ACI 301 Section 2. Provide for surfaces not exposed to public view a surface finish SF-1.0. Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301. Submit form removal schedule indicating element and minimum length of time for form removal.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Comply with ACI 301 Section 2 with surface tolerances in accordance with ACI 117.

3.2 INSPECTION

Inspect forms and embedded items in sufficient time prior to each concrete placement to certify to the Contracting Officer that they are ready to receive concrete. Report the results of each inspection in writing. Submit field inspection reports for concrete forms and embedded items.

END OF SECTION 01 32 00

SECTION 03 15 00

CONCRETE ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICES

1.2.1 Measurement and Payment

Concrete accessories will not be paid for directly. All costs of furnishing, fabrication, placement, labor and equipment shall be considered subsidiary to bid items for concrete.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 111	(2011; R 2015) Standard Method of Test for Mineral Matter or Ash in Asphalt Materials
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AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard
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ASME INTERNATIONAL (ASME)

ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
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ASTM INTERNATIONAL (ASTM)

ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and
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	Ultra-High Strength
ASTM A109/A109M	(2016) Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A480/A480M	(2017) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM B152/B152M	(2013) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B370	(2012) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C919	(2012; R 2017) Standard Practice for Use of Sealants in Acoustical Applications
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D2628	(1991; R 2016) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	(1989; R 2017) Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D4	(1986; R 2010) Bitumen Content
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2016a) Standard Test Method for Rubber Property - Effect of Liquids
ASTM D5249	(2010; R 2016) Standard Specification for Backer Material for Use with Cold-and Hot-Applied Joint Sealants in

Portland-Cement Concrete and Asphalt Joints

ASTM D6/D6M

(1995; E 2011; R 2011) Loss on Heating of Oil and Asphaltic Compounds

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513

(1974) Corps of Engineers Specifications for Rubber Waterstops

COE CRD-C 572

(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Shop Drawings:

Waterstops

Product Data:

Preformed Expansion Joint Filler Sealant
Waterstops

Samples:

Lubricant for Preformed Compression Seals Field-Molded Type
Waterstops
Splicing Waterstops

Certificates:

Preformed Expansion Joint Filler Sealant
Waterstops

1.5 DELIVERY, STORAGE, AND HANDLING

Protect material delivered and placed in storage off the ground from moisture, dirt, and other contaminants. Deliver sealants in the manufacturer's original unopened containers. Remove sealants from the site whose shelf life has expired.

PART 2 - PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Use 1/8 inch thick tempered hardboard contraction joint strips conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips must have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Use preformed expansion joint filler material conforming to ASTM D1751 or ASTM D1752, Type I, or resin impregnated fiberboard conforming to the physical requirements of ASTM D1752. Submit certified manufacturer's test reports for premolded expansion joint filler strips, compression seals and lubricant, and metallic waterstops to verify compliance with applicable specification. Unless otherwise indicated, filler material must be 3/8 inch thick and of a width applicable for the joint formed. Backer material, when required, must conform to ASTM D5249.

2.3 SEALANT

Joint sealant conforming to the following:

2.3.1 Preformed Polychloroprene Elastomeric Type ASTM D2628.

2.3.2 Lubricant for Preformed Compression Seals

ASTM D2835. Submit a piece not less than 9 ft of 1 inch nominal width or wider seal or a piece not less than 12 ft of compression seal less than 1 inch nominal width. Provide one quart of lubricant.

2.3.3 Field-Molded Type

ASTM C920. Use Type M, Grade P or NS, Class 25, Use [T] [NT] sealant for horizontal joints. Type M, Grade NS, Class 25, Use NT for vertical joints. [Except, the joint sealant that will be submerged underwater for part or all of its service life must meet the requirements of USE I.] Use polyethylene tape, coated paper, metal foil or similar type materials as bond breaker. The back-up material must be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber. Submit 4 1 gallon of field-molded sealant and 1 quart of primer (when primer is recommended by the sealant manufacturer) identified to indicate manufacturer, type of material, quantity, and shipment or lot represented.

2.4 WATERSTOPS

Submit a sample of each material consisting of a piece not less than 12 inches long cut from each 200 feet of finished waterstop furnished, but not less than a total of 4 linear feet of each type and size furnished. For spliced segments of waterstops to be installed in the work, furnish one spliced sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site for inspection and testing. Make the spliced samples using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop; the total length of each spliced sample not less than 12 inches. Submit waterstop materials and splice samples for inspection and testing identified to indicate manufacturer, type of material, size and quantity of material and shipment represented. Submit a shop drawing of the waterstops showing the placement and configuration.

2.4.1 Non-Metallic Materials`

Manufacture non-metallic waterstops from a prime virgin resin; reclaimed material is not acceptable. The compound must contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops conforming to COE CRD-C 513. Polyvinylchloride waterstops conforming to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops conforming to ASTM D471. Submit a piece not less than 12 inch long cut from each 200 ft of finished waterstop furnished, but not less than a total of 4 ft of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. Make the splice samples using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop; the total length of each splice not less than 12 inches long.

2.4.4 Non-Metallic Hydrophilic

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water conforming to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F shall be 3 to 1 minimum.

2.4.5 Preformed Plastic Adhesive

Produce preformed plastic adhesive waterstops from blends of refined hydrocarbon resins and plasticizing

compounds reinforced with inert mineral filler, containing no solvents, asbestos, irritating fumes or obnoxious odors. The compound cannot depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength.

2.4.5.1 Chemical Composition

Meet the chemical composition of the sealing compound requirements shown below:

PERCENT BY WEIGHT			
COMPONENT	MINIMUM	MAXIMUM	TEST
Bitumen (Hydrocarbon plastic)	50	70	ASTM D4
Inert Mineral Filler	30	50	AASHTO T 111
Volatile Matter		2	ASTM D6/D6M

2.4.5.2 Adhesion Under Hydrostatic Pressure

The sealing compound must not leak at the joints for a period of 24 hours under a vertical 6 foot head pressure. In a separate test, the sealing compound must not leak under a horizontal pressure of 10 psi which is reached by slowly applying increments of 2 psi every minute.

2.4.5.3 Sag of Flow Resistance

Sagging must not be detected when tested as follows: Fill a wooden form 1 inch wide and 6 inches long flush with sealing compound and place in an oven at 135 degrees F in a vertical position for 5 days.

2.4.5.4 Chemical Resistance

The sealing compound when immersed separately in a 5 percent solution of caustic potash, a 5 percent solution of hydrochloric acid, 5 percent solution of sulfuric acid and a saturated hydrogen sulfide solution for 30 days at ambient room temperature must show no visible deterioration.

2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

2.5.1 Materials Tests

2.5.1.1 Field-Molded Sealants

Test samples of sealant and primer, when use of primer is recommended by the manufacturer, as required in paragraph FIELD-MOLDED TYPE, by and at the expense of the TPWD for compliance with paragraph FIELD-MOLDED TYPE. If the sample fails to meet specification requirements, provide new samples and the cost of retesting will be deducted from payments due the Contractor.

2.5.1.2 Non-Metallic Waterstops

Samples of materials and splices will be visually inspected and tested by and at the expense of the TPWD for compliance with COE CRD-C 513 or COE CRD-C 572 as applicable. If a sample fails to meet the specification requirements, provide new samples and the cost of retesting will be deducted from payments due the Contractor.

2.5.2 Splicing Waterstops

2.5.2.1 Procedure and Performance Qualifications

Demonstrate procedure and performance qualifications for splicing waterstops in the presence of the Contracting Officer. Submit procedures for splicing waterstops for approval.

2.5.2.2 Non-Metallic Waterstops

Demonstrate procedure and performance qualifications for splicing non-metallic waterstops by the manufacturer at the factory and the Contractor at the job site by each making three spliced samples of each size and type of finished waterstop.

PART 3 - EXECUTION

3.1 INSTALLATION

Provide joint locations and details, including materials and methods of installation of joint fillers and waterstops, as specified and indicated. In no case may any fixed metal be continuous through an expansion or contraction joint.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Make joints 1/8 inch to 3/16 inch wide and extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

3.1.1.1 Joint Strips

Provide strips of the required dimensions and as long as practicable. After the first floating, groove the concrete with a tool at the joint locations. Insert the strips in the groove and depress them until the top edge of the vertical surface is flush with the surface of the slab. Float and finish the slab as specified. Work of the concrete adjacent to the joint the minimum necessary to fill voids and consolidate the concrete. Where indicated, saw out the top portion of the strip after the curing period to form a recess for sealer. Discard the removable section of PVC or HIPS strips and leave the insert in place. Maintain true alignment of the strips during insertion.

3.1.1.2 Sawed Joints

Saw joints early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Start cutting as soon as the concrete has hardened sufficiently to prevent raveling of the edges of the saw cut. Complete cutting before shrinkage stresses become sufficient to produce cracking. Use concrete sawing machines that are adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Cut joints to true alignment and in sequence of concrete placement. Remove sludge and cutting debris. Form reservoir for joint sealant.

3.1.1.3 Bond Breaker

Coat joints requiring a bond breaker with curing compound or with bituminous paint. Protect waterstops during application of bond breaking material to prevent them from being coated.

3.1.2 Expansion Joints

Use preformed expansion joint filler in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. Extend the filler to the full slab depth, unless otherwise indicated.

neatly finish the edges of the joint with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, install the filler strips at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. Remove the wood strip after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. Thoroughly clean the groove of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust. If blowing out the groove use oil-free compressed air.

3.1.3 Joint Sealant

Fill sawed contraction joints and expansion joints in slabs with joint sealant, unless otherwise shown. Joint surfaces must be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Apply joint sealant as recommended by the manufacturer of the sealant.

3.1.3.1 Joints With Preformed Compression Seals

Install compression seals with equipment capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal or concrete and with no more than 5 percent stretching of the seal. Cover the sides of the joint and, if necessary, the sides of the compression seal with a coating of lubricant. Coat butt joints with liberal applications of lubricant.

3.1.3.2 Joints With Field-Molded Sealant

Do not seal joints when the sealant material, ambient air, or concrete temperature is less than 4 degrees C 40 degrees F. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors follow the guidance provided in ASTM C919. Coat joints requiring a bond breaker with curing compound or with bituminous paint. Install bond breaker and back-up material where required. Prime joints and fill flush with joint sealant in accordance with the manufacturer's recommendations.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Install waterstops at the locations shown to form a continuous water-tight diaphragm. Make adequate provision to support and completely protect the waterstops during the progress of the work. Repair or replace any waterstop punctured or damaged. Protect exposed waterstops during application of form release agents to avoid being coated. Provide suitable guards to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Accomplish splices with certified trained personnel using approved equipment and procedures.

3.2.1 Non-Metallic

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. Use a miter guide, proper fixturing (profile dependant), and portable power saw to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. Splice straight lengths by squaring the ends to be joined. Maintain continuity of the characteristic features of the cross section of the waterstop (for example, ribs, tabular center axis, protrusions) across the splice.

3.2.1.1 Rubber Waterstop

Vulcanize splices or make using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R must be as specified for PVC.

3.2.1.2 Polyvinyl Chloride Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Use the correct temperature to sufficiently melt without charring the plastic. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.1.3 Quality Assurance

Edge welding will not be permitted. Compress or close centerbulbs when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following:

- 1) Tensile strength less than 80 percent of parent section.
- 2) Free lap joints.
- 3) Misalignment of centerbulb, ribs, and end bulbs greater than 2 mm 1/16 inch.
- 4) Misalignment which reduces waterstop cross section more than 15 percent.
- 5) Bond failure at joint deeper than 2 mm 1/16 inch or 15 percent of material thickness.
- 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 13 mm in 3 m 1/2 inch in 10 feet.
- 7) Visible porosity in the weld area, including pin holes.
- 8) Charred or burnt material.
- 9) Bubbles or inadequate bonding.
- 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.2 Non-Metallic Hydrophilic Waterstop Installation

Miter cut ends to be joined with sharp knife or shears. Adhere the ends with cyanacrylate (super glue) adhesive. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. Apply a liberal amount of a single component hydrophilic sealant to the junction to complete the transition.

3.2.3 Preformed Plastic Adhesive Installation

Install preformed plastic adhesive waterstops employing a prime, peel, place and pour procedure. Clean and dry joint surfaces before priming and just prior to placing the sealing strips. Splice the end of each strip to the next strip with a 25 mm 1 inch overlap; press the overlap firmly to release trapped air. During damp or cold conditions, flash the joint surface with a safe, direct flame to warm and dry the surface adequately; dip the sealing strips in warm water to soften the material to achieve maximum bond to the concrete surface.

3.3 CONSTRUCTION JOINTS

Treat construction joints coinciding with expansion and contraction joints as expansion or contraction joints as applicable.

END OF SECTION 03 15 00

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICES

1.2.1 Measurement and Payment

Reinforcing steel will not be measured on paid for directly. All costs of furnishing, fabrication, placement, ties, chais, bendings, splicing, labor and equipment shall be considered subsidiary to bids for concrete.

1.2.2 Accessories

No payment will be made for costs associated with furnishing and placing accessories incidental to and included in the payment for other items of work.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 318M	(2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	(2004) ACI Detailing Manual AMERICAN WELDING SOCIETY (AWS)
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing

Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1035/A1035M	(2016a) Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A184/A184M	(2017) Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A370	(2017a) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A675/A675M	(2014) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A706/A706M	(2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2016) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A884/A884M	(2014) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed; Errata) Manual of Standard Practice
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1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Preconstruction Submittals:	Butt-Splices
Shop Drawings:	Reinforcement

Product Data:	Mechanical Butt-Splices Reinforcing Steel
Test Reports:	Tests, Inspections, and Verifications
Certificates:	Reinforcing Steel Qualified Welders Qualification of Steel Bar Butt-Splicers

1.5 QUALITY ASSURANCE

1.5.1 Welding Qualifications

Welders are required to be qualified in accordance with AWS D1.4/D1.4M. Perform qualification test at the worksite and notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4/D1.4M. Submit a list of qualified welders names.

1.5.2 Qualification of Steel Bar Butt-Splicers

Qualification of steel bar butt-splicers are required to be certified to have satisfactorily completed a course of instruction in the proposed method of butt-splicing or have satisfactorily performed such work within the preceding year. Submit certificates on the Qualifications of Steel Bar Butt-Splicers prior to commencing butt-splicing.

1.5.3 Qualification of Butt-Splicing Procedure

As a condition of approval of the butt-splicing procedure, make three test butt-splices of steel bars of each size to be spliced using the proposed butt-splicing method, in the presence of the Contracting Officer. Tension tested to destruction these test butt-splices and unspliced bars of the same size, with stress-strain curves plotted for each test. Test results must show that the butt-splices meet the specified strength and deformation requirements in order for the splicing procedure to be approved.

1.6 DELIVERY, STORAGE, AND HANDLING

Store reinforcement and accessories off the ground on platforms, skids, or other supports.

PART 2 - PRODUCTS

2.1 DOWELS

Provide dowels conforming to ASTM A675/A675M, Grade 80

2.2 FABRICATED BAR MATS

Fabricated bar mats conforming to ASTM A184/A184M.

2.3 REINFORCING STEEL

Reinforcing steel of deformed bars conforming to ASTM A615/A615M, ASTM A706/A706M, or ASTM A1035/A1035M grades and sizes as indicated. Cold drawn wire used for spiral reinforcement must conform to ASTM A1064/A1064M.

Submit certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25

percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

See Structural General notes sheet S100 in the drawings for required reinforcing steel grades and other material requirements.

2.3.3 Mechanical Butt-Splices

Mechanical butt splices must be an approved exothermic, threaded coupling, swaged sleeve or other positive connecting type, and develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. In addition to this strength requirement, the additional deformation of number 14 and smaller bars due to slippage or other movement within the splice sleeve cannot exceed 0.015 inches unit strain 0.0015 inches/inch beyond the elongation of an unspliced bar based upon a 10 inch gage length spanning the extremities of the sleeve at a stress of 30,000 psi. The additional deformation of number 18 bars must not exceed 0.03 inches (unit strain 0.003 inches/inch) beyond the elongation of an unspliced bar based upon a 250 mm 10 inch gage length spanning the extremities of the sleeve at a stress of 30,000 psi. Determine the amount of the additional deformation from the stress-strain curves of the unspliced and spliced bars tested as required in paragraph QUALIFICATION OF BUTT-SPLICING PROCEDURE for qualification of the butt-splicing procedure.

2.4 WELDED WIRE REINFORCING

Welded wire reinforcing conforming to ASTM A1064/A1064M. When directed by the Contracting Officer for special applications, use welded wire reinforcing conforming to ASTM A884/A884M. For wire with a specified yield strength (f_y) exceeding 60,000 psi, f_y must be the stress corresponding to a strain of 0.35 percent.

2.5 WIRE TIES

Use wire ties that are 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Provide bar supports complying with the requirements of ACI SP-66. Provide plastic-coated wire, stainless steel or precast concrete supports for bars in concrete with formed surfaces exposed to view or to be painted. Use wedge-shaped precast concrete supports, not larger than 3-1/2 by 3-1/2 inches, of thickness equal to that indicated for concrete cover and with an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view must be the same quality, texture and color as the finish surfaces.

2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests, specified and required by applicable standards, by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Perform and certify tests, inspections, and verifications and certify. Submit certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications for each steel shipment and identified with specific lots prior to placement. Submit three copies of the heat analyses for each lot of steel furnished certifying that the steel conforms to the heat analyses.

2.7.1 Reinforcement Steel Tests

Perform mechanical testing of steel in accordance with ASTM A370 except as otherwise specified or required by the material specifications. Perform tension tests on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. From chemical analyses of steel heats report the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel.

2.7.2 Non-Destructive Testing of Welds

Perform non-destructive testing of welds in accordance with AWS D1.4/D1.4M Section 7, except that radiographic testing is not permitted.

PART 3 - EXECUTION

3.1 REINFORCEMENT

Fabricate and place reinforcement steel and accessories as specified, as indicated, and as shown on approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown must be in accordance with ACI SP-66 and ACI 318M ACI 318. Cold bend reinforcement unless otherwise authorized. Bending may be accomplished in the field or at the mill. Do not bend bars after embedment in concrete. Place safety caps on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Face wire tie ends away from the forms. Submit detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Show support details including types, sizes and spacing.

Reinforcement must be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Place reinforcement in accordance with ACI 318M ACI 318 at locations indicated plus or minus one bar diameter. Do not continue reinforcement through expansion joints and place as indicated through construction or contraction joints. Cover with concrete coverage as indicated or as required by ACI 318M ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, requires approval before concrete is placed.

3.1.1 Placing Tolerances

Conform bar spacing and concrete cover to ACI 117.

3.1.2 Splicing

Conform splices of reinforcement to ACI 318M ACI 318 and make only as required or indicated. Bars may be spliced at alternate or additional locations at no additional cost to the TPWD subject to approval. Splicing must be by lapping or by mechanical or welded butt connection; except that lap splices must not be used for bars larger than No. 11 unless otherwise indicated.

3.1.2.1 Lap Splices

Place lapped bars in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Do not space lapped bars farther apart than 1/5 the required length of lap or 6 inches.

3.1.2.2 Butt-Splices

Use butt-splices only for splicing size 14 and 18 bars and for splicing #11 bars to larger bars except where otherwise shown or authorized. Make butt-splices by a method which develops splices suitable for tension, compression and stress reversal applications. Butt-splices must develop 90 percent of the specified minimum ultimate tensile strength of the smallest bar of each splice. Clean bars of all oil, grease, dirt, rust, scale and other foreign substances and flame dry before splicing. Provide jigs and clamps or other devices to support, align and hold the longitudinal centerline of the bars to be butt-spliced in a straight line. Submit proposed procedure for butt-splicing steel bars prior to making the test butt-splices for qualification of the procedure. Include properties and analyses of steel bars and splicing materials in the submitted procedure. Report physical properties of splicing sleeves to include length, inside and outside diameters, and inside surface details.

3.1.2.3 Welded Butt Splices

Fabricate welded butt splices in accordance with AWS D1.4/D1.4M.

3.1.2.4 Mechanical Butt-Splices

Fabricate mechanical butt-splices in accordance with the mechanical splicing device manufacturer's recommendations. Bars to be spliced by a mechanical butt-splicing process may be sawed, sheared or flame cut provided the ends of sheared bars are reshaped after shearing and all slag is removed from the ends of flame cut bars by chipping and wire brushing prior to splicing. Clean surfaces to be enclosed within a splice sleeve or coupling by wire brushing or other approved method prior to splicing. Make splices using manufacturer's standard jigs, clamps, ignition devices and other required accessories. Longitudinally stagger tension splices of number 14 or smaller bar a minimum of 5 feet or as otherwise indicated so that no more than half of the bars are spliced at any one section. Longitudinally stagger tension splices of number 18 bars a minimum of 5 feet so that no more than 1/3 of the bars are spliced at any one section.

3.2 WELDED-WIRE REINFORCEMENT PLACEMENT

Place welded-wire reinforcement in slabs as indicated. Reinforcement placed in slabs on grade must be continuous between expansion, construction, and contraction joints. Reinforcement placement at joints must be as indicated.

May lap splices in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Stagger laps to avoid continuous laps in either direction. Wire or clip together reinforcement at laps at intervals not to exceed 4 feet. Position reinforcement by the use of supports.

3.3 DOWEL INSTALLATION

Install dowels in slabs on grade at locations indicated and at right angles to joint being doweled. Accurately position and align dowels parallel to the finished concrete surface before concrete placement. Rigidly support dowels during concrete placement. Coat one end of dowels with a bond breaker.

3.4 FIELD TESTS AND INSPECTIONS

3.4.1 Identification of Splices

Establish and maintain an approved method of identification of all field butt-splices which will indicate the splicer and the number assigned each splice made by the splicer.

3.4.2 Examining, Testing, and Correcting

Perform the following during the butt-splicing operations as specified and as directed:

3.4.2.1 Visual Examination

Visually examine all welded splices as required by AWS D1.4/D1.4M. Respliced connections resulting from correction of visual defects may be examined by non-destructive testing at the option of the Contracting Officer as specified in paragraph SUPPLEMENTAL EXAMINATION. Visually examine exothermic mechanical butt-splices to determine if the filler metal is clearly visible at the tap holes and completely fills the sleeves at both ends except for spaces of not more than 3/8 inch occupied by packing.

3.4.2.2 Tension Tests

Perform tensions tests to 90 percent of the minimum specified ultimate tensile strength of the spliced bars or to destruction on one test specimen made in the field for every 25 splices made. Test specimens must be made by the splicers engaged in the work, using the approved splicing procedure and the same size bars placed in the same relative position, and under the same conditions as those in the groups represented by the specimens. Furnish stress-strain curves for each butt-splice tested.

3.4.2.3 Non-destructive Testing of Welded Splices

Examine not less than one of each 25 welded splices selected at random by the Contracting Officer by non-destructive testing and evaluate for defects in accordance with AWS D1.4/D1.4M Section 7, except that radiographic testing is not permitted.

3.4.2.4 Correction of Deficiencies

Do not embed splice in concrete until satisfactory results of visual examination and the required tests or examinations have been obtained. Remove all splices having visible defects or represented by test specimens which do not satisfy the tests or examinations. If any of the tension test specimens fail to meet the strength requirements or deformation limitations cut out two production splices from the same lot represented by the test specimens which failed and tension test. If both of the retests pass the strength requirements and deformation limitations all of the splices in the lot will be accepted. If one or both of the retests fail to meet the strength requirements or deformation limitations all of the splices in the lot will be rejected. Cut off the bars of rejected splices outside the splice zone of weld metal, filler metal contact, coupling or sleeve. Finish the cut ends as specified, resplice and reinspect the joints.

3.4.2.5 Supplemental Examination

The Contracting Officer may require additional or supplemental non-destructive testing and/or tension test of any completed splice. For costs of such examinations and tests see paragraph UNIT PRICES.

END OF SECTION 03 20 00

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICES

1.2.1 Measurement

Unit of Measure: Cubic Yard

Measurement of concrete for payment will be made on the basis of the actual volume within the pay lines of the structure as indicated on the contract drawings. Measurement for payment of concrete placed against the sides of any excavation without intervening forms will be made only within the pay lines of the structure as shown on the contract drawings. No deductions will be made for rounded or beveled edges, for space occupied by metal work, for conduits, for voids, or for embedded items which are less than 5 cubic feet in volume or 1 square foot in cross section.

1.2.2 Payment

Unless otherwise specified, payment for concrete will be made at the respective unit prices per cubic yard for the various items of the schedule, measured as specified above, which price includes the cost of all labor, materials, formwork, reinforcing, finishing, curing, accessories, embedded items and the use of equipment and tools required to complete the concrete work.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	(1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 214R	(2011) Evaluation of Strength Test Results of Concrete
ACI 301	(2016) Specifications for Structural Concrete
ACI 304.2R	(2017) Guide to Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305.1	(2014) Specification for Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 309R	(2005) Guide for Consolidation of Concrete
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI SP-15	(2011) Field Reference Manual: Standard Specifications for Structural Concrete ACI 301-05 with Selected ACI References

ASTM INTERNATIONAL (ASTM)

ASTM C1017	(2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064	(2017) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1107	(2017) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1157	(2017) Standard Performance Specification for Hydraulic Cement
ASTM C1240	(2014) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	(2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C131/C131M	(2014) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los

Angeles Machine

ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143/C143M	(2015) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2018) Standard Specification for Portland Cement
ASTM C1567	(2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2016a) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2018b) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C311/C311M	(2017) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2018) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2018) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	(2017) Standard Specification for Chemical Admixtures for Concrete
ASTM C496/C496M	(2017) Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

ASTM C595/C595M	(2018) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2017a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	(2017) Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C78/C78M	(2018) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C937	(2016) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C94/C94M	(2017a) Standard Specification for Ready-Mixed Concrete
ASTM C979	(2018) Integral Colored Concrete
ASTM C989/C989M	(2018) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D5759	(2012) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D75/D75M	(2014) Standard Practice for Sampling Aggregates
ASTM E1643	(2018a) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
ASTM E1745	(2017) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E1993/E1993M	(1998; R 2013; E 2013) Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed; Errata) Manual of Standard Practice
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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(2018) Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices
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NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(2000; R 2006) Concrete Plant Standards
NRMCA QC 3	(2015) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104

(1980) Method of Calculation of the Fineness Modulus of Aggregate

1.4 Definitions

1.4.1 Cementitious Material

As used herein, includes all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume.

1.4.2 Chemical Admixtures

Materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

1.4.3 Complementary Cementing Materials (CCM)

Coal fly ash, silica fume, granulated blast-furnace slag, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in considerable improvement to sustainability, durability.

1.4.4 Design Strength (f'_c)

The specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.

1.4.5 Mass Concrete

Any concrete system that approaches a maximum temperature of 158 degrees F within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 3 feet or more regardless of temperature.

1.4.6 Mixture Proportioning

The process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project.

1.4.7 Mixture Proportions

The masses or volumes of individual ingredients used to make a unit measure (cubic yard) of concrete.

1.4.8 Pozzolan

Siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

1.4.9 Workability or Consistency

The ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.5 SUBMITTALS

Submit the following in accordance with TPWD UGC:

Preconstruction Submittals:	Quality Control Plan Laboratory Accreditation Sampling Plan
Product Data:	Recycled Content Products; (LEED) Cementitious Materials Vapor Retarder Vapor Barrier Floor Finish Floor Hardener Chemical Admixtures
Samples:	Surface Retarder
Design Data:	Mixture Proportions Lightweight Aggregate Concrete
Test Reports:	Mixture Proportions Testing and Inspection for CQC Fly Ash Air Content Slump Compressive Strength Water
Certificates:	Contractor Quality Control personnel Ready-Mix Plant
Sample Panels:	2 x 2 feet to demonstrate finish, color and texture

1.6 QUALITY ASSURANCE

Submit qualifications for Contractor Quality Control personnel assigned to concrete construction as American Concrete Institute (ACI) Certified Workmen in one of the following grades or show written evidence of having completed similar qualification programs:

Concrete Field Testing Technician	Grade I
Concrete Laboratory Testing Technician	Grade I or II
Concrete Construction Inspector	Level II
Concrete Transportation Construction Inspector or Reinforced Concrete Special Inspector	Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Code Council (ICC), and Southern Building Code Congress International (SBCCI)

Foreman or Lead Journeyman of the flatwork finishing crew	Similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation
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1.6.1 Laboratory Accreditation

Provide laboratory and testing facilities. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

1.6.1.1 Aggregate Testing and Mix Proportioning

Perform aggregate testing and mixture proportioning studies in an accredited laboratory, under the direction of a registered professional engineer in a U.S. state or territory who is competent in concrete materials. This person is required to sign all reports and designs.

1.6.1.2 Acceptance Testing

Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.

1.6.1.3 Contractor Quality Control

All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.6.2 Quality Control Plan

Submit a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. Identify the approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. Provide all quality control reports to the Quality Manager, Concrete Supplier and the Contracting Officer. Maintain a copy of ACI SP-15 and CRSI 10MSP at the project site.

1.6.3 Pre-installation Meeting

A pre-installation meeting with the Contracting Officer is required at least 10 days prior to start of construction. Conduct the meeting with the Project Superintendent and active installation personnel present.

1.6.4 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Include any of these materials to be used on the project in the mix design studies.

1.6.5 TPWD Assurance Inspection and Testing

Day-to day inspection and testing is the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the CQC staff. TPWD inspection or testing will not relieve any CQC responsibilities.

1.6.5.1 Materials

The TPWD will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D75/D75M. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.6.5.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C172/C172M and tested in accordance with these specifications, as considered necessary.

1.6.5.3 Hardened Concrete

Tests on hardened concrete will be performed by the TPWD when such tests are considered necessary.

1.6.5.4 Inspection

Concrete operations may be tested and inspected by the TPWD as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the TPWD for final acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301 and ACI 304R requirements and recommendations. Store cement and other cementitious materials in weathertight buildings, bins, or silos that exclude moisture and contaminants and keep each material completely separated. Arrange and use aggregate stockpiles in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Do not store aggregate directly on ground unless a sacrificial layer is left undisturbed. Store reinforcing bars and accessories above the ground on platforms, skids or other supports. Store other materials in a manner to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing cannot be used unless retested and proven to meet the specified requirements. Materials must be capable of being accurately identified after bundles or containers are opened.

PART 2 - PRODUCTS

In accordance with Section 01 33 29 SUSTAINABILITY REPORTING submit documentation indicating: distance between manufacturing facility and the project site, distance of raw material origin from the project site, percentage of post-industrial and post-consumer recycled content per unit of product and relative dollar value of recycled content products to total dollar value of products included in project. Provide Submittals as specified in the subject Section.

2.1 SYSTEM DESCRIPTION

Provide concrete composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

2.1.1 Proportioning Studies-Normal Weight Concrete

Trial design batches, mixture proportions studies, and testing requirements for various types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M. Obtain mix design approval from the Contracting Officer prior to concrete placement.

- a. Samples of all materials used in mixture proportioning studies must be representative of those

proposed for use in the project and be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications.

- b. Make trial mixtures having proportions, consistencies, and air content suitable for the work based on methodology described in ACI 211.1, using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required on the project.
- c. The maximum water-cementitious material ratios allowed in subparagraph WATER-CEMENTITIOUS MATERIAL RATIO below will be the equivalent water-cementitious material ratio as determined by conversion from the weight ratio of water to cement plus pozzolan by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, include the weight of the silica fume and GGBF slag in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content is 15 percent by weight of the total cementitious material, and the maximum is 35 percent.
- d. Design laboratory trial mixtures for maximum permitted slump and air content. Make separate sets of trial mixture studies for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either may be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies must also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months.
- e. Report the temperature of concrete in each trial batch. For each water-cementitious material ratio, make at least three test cylinders for each test age, cure in accordance with ASTM C192/C192M and test at 7 and 28 days in accordance with ASTM C39/C39M. From these test results, plot a curve showing the relationship between water-cementitious material ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 day and 28 day strengths. Design each mixture to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.
- f. Submit the results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength of concrete, at least 60 days prior to commencing concrete placing operations. Base aggregate weights on the saturated surface dry condition. Accompany the statement with test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions may be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

2.1.2 Average Compressive Strength

The mixture proportions selected during mixture design studies must produce a required average compressive strength (f'_{cr}) exceeding the specified compressive strength (f'_c) by the amount indicated below, but may not exceed the specified strength at the same age by more than 20 percent.

This required average compressive strength, f'_{cr} , will not be a required acceptance criteria during concrete production.

However, whenever the daily average compressive strength at 28 days drops below f'_{cr} during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'_{cr} , adjust the mixture, as approved, to bring the daily average back up to f'_{cr} . During production, the required f'_{cr} must be adjusted, as appropriate, based on the standard deviation being attained on the job.

2.1.3 Computations from Test Records

Where a concrete production facility has test records, establish a standard deviation in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated must represent materials, quality control procedures, and conditions similar to those expected; must represent concrete produced to meet a specified strength or strengths (f'_c) within 1000 psi of that specified for proposed work; and must consist of at least 30 consecutive tests. A strength test must be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'_{cr} used as the basis for selection of concrete proportions must be in accordance with ACI 318 Chapter 5.

2.1.4 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices must be in accordance with ACI 117. Take level and grade tolerance measurements of slabs as soon as possible after finishing; when forms or shoring are used, the measurements must be made prior to removal.

2.1.5 Floor Finish

For floor finishes, see Section 03 35 00 CONCRETE FINISHING.

2.1.6 Strength Requirements

Specified compressive strength (f'_c) must be as follows, unless otherwise specified in the plans:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
4000 psi at 28 days	All Concrete

Concrete made with high-early strength cement must have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength must be determined in accordance with ASTM C39/C39M.

2.1.8.1 Evaluation of Concrete Compressive Strength

Fabricate six compressive strength specimens, 6 inch by 12 inch cylinders, laboratory cure them in accordance with ASTM C31/C31M and test them in accordance with ASTM C39/C39M. Test two cylinders at 7 days, two cylinders at 28 days and hold two cylinder in reserve. The strength of the concrete is considered satisfactory so long as the average of all sets of three consecutive test results do not exceed the specified compressive strength f'_c by 20 percent and no individual test result falls below the specified strength f'_c by more than 500 psi), unless approved by the Contracting Officer. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required when the strength of the concrete in the structure is considered potentially deficient.

2.1.8.2 Investigation of Low-Strength Compressive Test Results

When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, take steps to assure that the

load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, obtain cores and test in accordance with ASTM C42/C42M. Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) may not be used as a basis for acceptance or rejection. Perform the coring and repair the holes; cores will be tested by the TPWD.

2.1.8.3 Load Tests

If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318M ACI 318. Correct concrete work evaluated by structural analysis or by results of a load test as being understrength in a manner satisfactory to the Contracting Officer. Perform all investigations, testing, load tests, and correction of deficiencies approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the TPWD.

2.1.9 Water-Cementitious Material Ratio

Maximum water-cementitious material ratio (w/c) for normal weight concrete is as follows:

WATER-CEMENTITIOUS MATERIAL RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.45	All Concrete

2.1.10 Air Entrainment

Air entrain normal weight concrete based on the following table, except as otherwise specified for lightweight concrete.

MINIMUM AIR CONTENT Percent	STRUCTURE OR PORTION OF STRUCTURE
5.0	All normal weight concrete

Attain specified air content at point of placement into the forms within plus or minus 1.5 percent. Determine air content for normal weight concrete in accordance with ASTM C231/C231M.

2.1.11 Slump

Slump of the concrete, as delivered to the point of placement into the forms, must be within the following limits, unless otherwise specified in the drawings – see Structural General Notes sheet S100. Structural general Notes shall take precedence over the limits below. Determine slump in accordance with ASTM C143/C143M.

Structural Element	Slump inches	
	Minimum	Maximum
Walls, columns and beams	2	4
Foundation walls, substructure walls, footings, slabs	1	3
Any structural concrete approved for placement by pumping:		
At pump	2	8
At discharge of line	1	4

When use of a plasticizing admixture conforming to ASTM C1017/C1017M or when a Type F or G high range water reducing admixture conforming to ASTM C494/C494M is permitted to increase the slump of concrete, concrete must have a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

2.1.12 Concrete Temperature

The temperature of the concrete as delivered must not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered must be between 55 and 75 degrees F.

2.1.13 Size of Coarse Aggregate

Use the largest feasible nominal maximum size aggregate (NMSA), specified in PART 2 paragraph AGGREGATES, in each placement. However, do not exceed nominal maximum size of aggregate for any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

2.2 CEMENTITIOUS MATERIALS

Cementitious Materials must be portland cement, portland-pozzolan cement, or portland cement in combination with pozzolan conforming to appropriate specifications listed below. Restrict usage of cementitious materials in concrete that will have surfaces exposed in the completed structure so there is no change in color, source, or type of cementitious material.

2.2.1 Portland Cement

ASTM C150/C150M, Type I II III low alkali with a maximum 10 percent amount of tricalcium aluminate, and a maximum cement-alkali content of 0.80 percent Na₂O_e (sodium oxide) equivalent.

2.2.2 High-Early-Strength Portland Cement

ASTM C150/C150M, Type III with tricalcium aluminate limited to 5 percent, low alkali. Use Type III cement only in isolated instances and only when approved in writing.

2.2.4 Fly Ash

Conform fly ash to ASTM C618, Class F, except that the maximum allowable loss on ignition cannot exceed 3 percent. If

pozzolan is used, it must never be less than 15 percent by weight of the total cementitious material. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759. Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

2.2.5 Raw or Calcined Natural Pozzolan

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and must have an on ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

2.2.6 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Conform Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age is at least 95 percent of the control specimens.
- b. The average particle size does not exceed 6 microns.
- c. The sum of $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ is greater than 77 percent.

2.2.7 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C989/C989M, Grade 120. Slag content must be a minimum of 25 percent by weight of cementitious material. Submit test results in accordance with ASTM C989/C989M for GGBF slag. Submit test results performed within 6 months of submittal date.

2.3 AGGREGATES

Test and evaluate fine and coarse aggregates for alkali-aggregate reactivity in accordance with ASTM C1260. Evaluate the fine and coarse aggregates separately and in combination, which matches the proposed mix design proportioning. All results of the separate and combination testing must have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1260 and ASTM C1567. Perform the additional testing using ASTM C1260 and ASTM C1567 using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. Use GGBF slag in the range of 40 to 50 percent of the total cementitious material by mass. Use Class F fly ash in the range of 25 to

40 percent of the total cementitious material by mass. Provide fine and coarse aggregates conforming to the following.

2.3.1 Fine Aggregate

Conform to the quality and gradation requirements of ASTM C33/C33M.

2.3.2 Coarse Aggregate

Conform to ASTM C33/C33M, Class 5S, size designation 57.

2.4 CHEMICAL ADMIXTURES

When required or permitted, conform to the appropriate specification listed. Furnish admixtures in liquid form and

of suitable concentration for easy, accurate control of dispensing.

2.4.1 Air-Entraining Admixture

ASTM C260/C260M and must consistently entrain the air content in the specified ranges under field conditions.

2.4.2 Accelerating Admixture

ASTM C494/C494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride cannot be used.

2.4.3 Water-Reducing or Retarding Admixture

ASTM C494/C494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived.

2.4.4 High-Range Water Reducer

ASTM C494/C494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. Use the admixture only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4.5 Surface Retarder

ASTM C309. Submit sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

2.4.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C937.

2.4.7 Other Chemical Admixtures

Provide chemical admixtures for use in producing flowing concrete in compliance with ASTM C1017/C1017M, Type I or II. Use these admixtures only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.5 WATER

Provide water complying with the requirements of ASTM C1602/C1602M. Provide [potable] water for mixing, free of injurious amounts of oil, acid, salt, or alkali. Submit test report showing water complies with ASTM C1602/C1602M.

2.6 NONSHRINK GROUT

Provide nonshrink grout conforming to ASTM C1107/C1107M, and a commercial formulation suitable for the proposed application.

2.7 NONSLIP SURFACING MATERIAL

Provide nonslip surfacing material consisting of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent

ferric oxide. Use well graded aggregate from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.8 EMBEDDED ITEMS

Provide the size and type indicated or as needed for the application. Dovetail slots must be galvanized steel. Provide hangers for suspended ceilings as specified in Section 09 51 00 ACOUSTICAL CEILINGS. Provide inserts for shelf angles and bolt hangers of malleable iron or cast or wrought steel.

2.9 JOINT MATERIALS

2.9.1 Joint Fillers, Sealers, and Waterstops

Provide materials for expansion joint fillers and waterstops in accordance with Section 03 15 00.00 10 CONCRETE ACCESSORIES. Provide materials for and sealing of joints conforming to the requirements of Section 07 92 00 JOINT SEALANTS

- Contraction Joints in Slabs

Provide materials for contraction joint inserts in accordance with Section 03 15 00 CONCRETE ACCESSORIES.

2.10 COLOR MATERIALS

Provide Integral concrete colorant: ASTM C979, factory-measured powder mix in self-dissolving packaging, consisting of non-fading, finely-ground synthetic mineral-oxide coloring pigments and water reducing agent. Color to be selected by TPWD. Add integral concrete colorant according to manufacturer's instructions. Maintain mix characteristics for all concrete required to have matching finish.

Color: CHROMIX C-15 'Coachella Sand' or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, perform the following: Clean surfaces to receive concrete, free from frost, ice, mud, and water. Place, clean, coat, and support forms in accordance with Section 03 11 13 STRUCTURAL CONCRETE FORMING. Place, clean, tie, and support reinforcing steel in accordance with Section 03 20 00 CONCRETE REINFORCEMENT. Transporting and conveying equipment is in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete is at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage is at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material is at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete as required in Section 03 39 00 CONCRETE CURING.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed is clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation must be well drained, satisfactorily graded and uniformly compacted.

3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed is free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Clean joints in rock to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, thoroughly clean rock surfaces by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Keep rock surfaces continuously moist for at least 24 hours immediately prior to placing concrete thereon. Cover all horizontal and approximately horizontal surfaces, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Place concrete before the mortar stiffens.

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 31 00 00 EARTHWORK. Place the concrete without becoming contaminated by loose material, and outlined within the specified tolerances.

3.1.2 Previously Placed Concrete

Prepare concrete surfaces to which additional concrete is to be bonded for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Prepare concrete at the side of vertical construction joints as approved by the Contracting Officer. Do not use air-water cutting on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces must be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. Do not undercut the edges of the coarse aggregate. Keep the surface of horizontal construction joints continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. Wash the surface completely clean as the last operation prior to placing the next lift. For heavy duty floors and two-course floors, thoroughly scrub a thin coat of neat cement grout of about the consistency of thick cream into the existing surface immediately ahead of the topping placing. The grout must be a 1:1 mixture of portland cement and sand passing the No. 8 sieve. Deposit the topping concrete before the grout coat has had time to stiffen.

3.1.2.1 Air-Water Cutting

Perform air-water cutting of a fresh concrete surface at the proper time and only on horizontal construction joints. The air pressure used in the jet must be 100 psi, plus or minus 10 psi, and the water pressure must be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of ASTM C309 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, wash and rinse the surface as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, use high-pressure waterjet or sandblasting as the last operation before placing the next lift.

3.1.2.2 High-Pressure Water Jet

Use a stream of water under a pressure of not less than 3,000 psi for cutting and cleaning. Delay its use until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, clean the surface by sandblasting.

3.1.2.3 Wet Sandblasting

Use wet sandblasting after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, thoroughly wash the surface of the concrete to remove all loose materials.

3.1.2.4 Waste Disposal

Dispose of waste water employed in cutting, washing, and rinsing of concrete surfaces in a manner that the waste water

does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal is subject to approval.

3.1.2.5 Preparation of Previously Placed Concrete

Abrade concrete surfaces to which other concrete is to be bonded in an approved manner that exposes sound aggregate uniformly without damaging the concrete. Remove laitance and loose particles. Thoroughly wash surfaces, leaving them moist but without free water when concrete is placed.

3.1.3 Embedded Items

Before placement of concrete, determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items must be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete is permitted only when specifically authorized or directed. Temporarily fill voids in sleeves, inserts, and anchor slots with readily removable materials to prevent the entry of concrete into voids. Do not weld on embedded metals within 12 inches of the surface of the concrete. Do not tack weld on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 General Requirements

Batch and mix concrete onsite or furnish from a ready-mixed concrete plant. Batch, mix, and transport ready-mixed concrete in accordance with ASTM C94/C94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units must comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities must be certified in accordance with NRMCA QC 3. Furnish approved batch tickets for each load of ready-mixed concrete. Conform site-mixed concrete to the following subparagraphs.

3.2.2 Batching Plant

Locate the batching plant onsite in the general area indicated or offsite close to the project. The batching, mixing and placing system must have a capacity of at least 100 cubic yards per hour. Conform the batching plant to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.3 Batching Equipment

Use semiautomatic or automatic batching controls as defined in NRMCA CPMB 100. Provide a semiautomatic batching system with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. Equip the batching system with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. Record the weight of water and admixtures if batched by weight. Provide separate bins or compartments for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Weigh aggregates either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Do not weigh aggregate in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first. Water may be measured by weight or volume. Do not weigh or measure water cumulatively with another ingredient. Interlock filling and discharging valves for the water metering or batching system so that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures must be free from leaks and valved to prevent backflow or siphoning. Furnish admixtures as a liquid of suitable concentration for easy control of dispensing. Provide an adjustable, accurate, mechanical device for measuring and dispensing each admixture. Interlock each admixture dispenser with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. Different admixtures cannot be combined prior to introduction in water and are not allowed to intermingle until in contact with the cement. Provide admixture dispensers with devices to detect and indicate flow during dispensing or

have a means for visual observation. Arrange the plant so as to facilitate the inspection of all operations at all times. Provide suitable facilities for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Clearly mark filling ports for cementitious materials bins or silos with a permanent sign stating the contents.

3.2.4 Scales

Conform the weighing equipment to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy must be plus or minus 0.2 percent of scale capacity. Provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. Perform the tests at the specified frequency in the presence of a TPWD inspector. Arrange the weighing equipment so that the plant operator can conveniently observe all dials or indicators.

3.2.5 Batching Tolerances

a. Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

b. Tolerances with Volumetric Equipment - For volumetric batching equipment used for water and admixtures, the following tolerances apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water	plus or minus 1
Chemical admixture	0 to plus 6

3.2.6 Moisture Control

Provide a plant capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.7 Concrete Mixers

Use stationary mixers or truck mixers capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. Do not charge the mixers in excess of the capacity recommended by the manufacturer. Operate the mixers at the drum or mixing blade speed designated by the manufacturer. Maintain the mixers in satisfactory operating condition, and keep the mixer drums free of hardened concrete. Should any mixer at any time produce unsatisfactory results, promptly discontinue its use until it is repaired.

3.2.8 Stationary Mixers

Drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or pug mill type provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. Conform the mixing time and uniformity to all the requirements in ASTM C94/C94M applicable to central-mixed concrete.

3.2.9 Truck Mixers

Conform truck mixers, the mixing of concrete therein, and concrete uniformity to the requirements of ASTM C94/C94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Equip each truck with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Or, if approved, mark the number of revolutions on the batch tickets.] Do not add water at the placing site unless specifically approved; and in no case can it exceed the specified w/c. Inject any such water at the base of the mixer, not at the discharge end.

3.3 TRANSPORTING CONCRETE TO PROJECT SITE

Transport concrete to the placing site in truck mixers.

3.4 PLACING CONCRETE

Discharge mixed concrete within 1.5 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, reduce the time to 45 minutes. Place concrete within 15 minutes after it has been discharged from the transporting unit. Handle concrete from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed.

Provide adequate scaffolding, ramps and walkways so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities prevent proper consolidation, finishing and curing. Provide sufficient placing capacity so that concrete can be kept free of cold joints.

3.7.1 Depositing Concrete

Deposit concrete in accordance with ACI 301 Section 5 and ACI 304.2R.

3.7.2 Consolidation

Immediately after placing, consolidate each layer of concrete in accordance with ACI 301 Section 5 and ACI 309R.

3.7.3 Cold Weather Requirements

Perform cold weather concreting in accordance with ACI 306.1. Use special protection measures, approved by the Contracting Officer, if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete must be not less than 40 degrees F. The temperature of the concrete when placed must be not less than 50 degrees F nor more than 75 degrees F. Heat the mixing water or aggregates to regulate the concrete placing temperature. Materials entering the mixer must be free from ice, snow, or frozen lumps. Do not incorporate salt, chemicals or other materials in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C494/C494M, Type C or E may be used, provided it contains no calcium chloride. Do not use calcium chloride.

3.7.4 Hot Weather Requirements

When job-site conditions are present or anticipated that accelerate the rate of moisture loss or rate of cement hydration of freshly mixed concrete, including an ambient temperature of 80 degrees F or higher, and an evaporation rate that

exceeds 0.2 lb/ft²/h, conform concrete work to all requirements of ACI 305.1.

3.7.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, be alert to the tendency for plastic shrinkage cracks to develop and institute measures to prevent this. Take particular care if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Conform with the requirement of ACI 305.1. In addition further protect the concrete placement by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Fill plastic shrinkage cracks that occur by injection of epoxy resin as directed, after the concrete hardens. Never trowel over plastic shrinkage cracks or fill with slurry.

3.7.7 Placing Concrete in Congested Areas

Use special care to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. Use an appropriate concrete mixture, with the nominal maximum size of aggregate (NMSA) meeting the specified criteria when evaluated for the congested area. Use vibrators with heads of a size appropriate for the clearances available, and closely supervise the consolidation operation to ensure complete and thorough consolidation at all points. Where necessary, alternate splices of reinforcing bars to reduce congestion. Where two mats of closely spaced reinforcing are required, place the bars in each mat in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.7.8 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C1017/C1017M is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete must meet all requirements of paragraph SYSTEM DESCRIPTION. Use extreme care in conveying and placing the concrete to avoid segregation. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.8 JOINTS

Locate and construct joints as indicated or approved. Locate and construct joints not indicated to minimize the impact on the strength of the structure. In general, locate such joints near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the offset joint in the girder a distance equal to twice the width of the beam. Locate joints in walls and columns at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Construct joints perpendicular to the main reinforcement. Continue and develop all reinforcement across joints; except that reinforcement or other fixed metal items must not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement must be inches clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces consist of preformed expansion joint filler extending for the full depth of the slab. The perimeters of the slabs must be free of fins, rough edges, spalling, or other unsightly appearance. Form reservoir for sealant for construction and contraction joints in slabs to the dimensions indicated by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Clean joints to be sealed and seal as indicated and in accordance with Section 07 92 00 JOINT SEALANTS.

3.8.1 Construction Joints

For concrete other than slabs on grade, locate construction joints so that the unit of operation does not exceed 75 feet. Place concrete continuously so that each unit is monolithic in construction. Do not place fresh concrete against adjacent hardened concrete until it is at least 24 hours old. Locate construction joints as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint

is subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, extend reinforcing steel through construction joints. Key or dowel construction joints in slabs on grade as indicated. Concrete columns, walls, or piers must be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, terminate lifts at the top and bottom of the opening. Terminate other lifts at such levels to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, tack a strip of 1 inch square-edge lumber, beveled and oiled to facilitate removal, to the inside of the forms at the construction joint. Place concrete to a point 1 inch above the underside of the strip. Remove the strip 1 hour after the concrete has been placed, level off any irregularities in the joint line with a wood float, and remove all laitance. Prior to placing additional concrete, prepare horizontal construction joints as specified in paragraph PREVIOUSLY PLACED CONCRETE.

3.8.2 Contraction Joints in Slabs on Grade

Locate and detail contraction joints as indicated. Produce contraction joints by forming a weakened plane in the concrete slab using materials and procedures specified in Section 03 15 00.00 10 CONCRETE ACCESSORIES.

3.8.3 Expansion Joints

conform installation of expansion joints and sealing of these joints to the requirements of Section 03 15 00.00 10 CONCRETE ACCESSORIES and Section 07 92 00 JOINT SEALANTS.

3.8.4 Waterstops

Install waterstops in conformance with the locations and details indicated using materials and procedures specified in Section 03 15 00.00 10 CONCRETE ACCESSORIES.

3.8.5 Dowels and Tie Bars

Install dowels and tie bars at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03 20 00 CONCRETE REINFORCEMENT and herein. Install conventional smooth "paving" dowels in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. Install "structural" type deformed bar dowels, or tie bars, to meet the specified tolerances. Take care during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.10 EXTERIOR SLAB AND RELATED ITEMS

3.10.1 Pavements

Construct pavements where shown on the drawings. After forms are set and underlying material prepared as specified, place the concrete uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, strike off the concrete and screed to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement is at the required elevation. Tamp the entire surface with the strike off, or consolidated with a vibrating screed, and continue this operation until the required compaction and reduction of internal and surface voids are accomplished. Take care to prevent bringing excess paste to the surface.

3.10.2 Sidewalks

Minimum concrete thickness of 4 inches. Provide contraction joints at 1.75 m 5 feet spaces unless otherwise indicated. Cut contraction joints 1 inch deep with a jointing tool after the surface has been finished. Provide transverse expansion joints 1/2 inch thick at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Provide a transverse slope of 1/4 inch per foot, unless otherwise indicated. Limit variations in cross section to 1/4 inch in 5 feet.

3.10.3 Curbs and Gutters

Form, place and finish concrete by hand using a properly shaped "mule" or construct using a slipform machine specially designed for this work. Cut contraction joints 3 inches deep with a jointing tool after the surface has been finished. Provide 1/2 inch wide expansion joints at 100 feet maximum spacing unless otherwise indicated.

3.10.4 Pits and Trenches

Construct pits and trenches as indicated. Place bottoms and walls monolithically or provide waterstops and keys as approved.

3.12.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar consists of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. Pack the space between the top of the concrete and bottom of the bearing plate or base with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.12.2 Nonshrink Grout

Ready-mixed material requiring only the addition of water. Water content must be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.12.2.1 Mixing and Placing of Nonshrink Grout

Mix and place in conformance with the material manufacturer's instructions and as specified therein. Thoroughly dry-mix ingredients before adding water. After adding water, mix the batch for 3 minutes. Size batches to allow continuous placement of freshly mixed grout. Discard grout not used within 30 minutes after mixing. Fill the space between the top of the concrete or machinery-bearing surface and the plate solid with the grout. Use wood forms or other equally suitable material for completely retain the grout on all sides and on top, remove forms after the grout has set. Carefully work the placed grout by rodding or other means to eliminate voids; however, avoid overworking and breakdown of the initial set. Do not subject grout to retempering or to vibration from any source. Where clearances are unusually small, place under pressure with a grout pump. Maintain the temperature of the grout, and of surfaces receiving the grout, at 65 to 85 degrees F until after setting.

3.12.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, cut back exposed surfaces 1 inch and immediately cover with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. Smooth finish the parge coat. For other mortars or grouts, exposed surfaces must have a smooth-dense finish and be left untreated. Cure in compliance with Section 03 39 00.00 10 CONCRETE CURING.

3.13 TESTING AND INSPECTION FOR CQC

Perform the inspection and tests described below and, based upon the results of these inspections and tests, take the action required. Submit certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

- a. When, in the opinion of the Contracting Officer, the concreting operation is out of control, cease concrete placement and correct the operation.
- b. The laboratory performing the tests must be onsite and conform with ASTM C1077. Materials may be subjected to check testing by the TPWD from samples obtained at the manufacturer, at transfer

points, or at the project site.

- c. The TPWD will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once thereafter for conformance with ASTM C1077.

3.13.1 Grading and Corrective Action

3.13.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there must be one sieve analysis and fineness modulus determination in accordance with ASTM C136/C136M and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. Select the location at which samples are taken as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, immediately resample and retest the fine aggregate. If there is another failure on any sieve, immediately report the failure to the Contracting Officer, stop concreting, and take immediate steps to correct the grading.

3.13.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there must be a sieve analysis in accordance with ASTM C136/C136M for each size of coarse aggregate. Select the location at which samples are taken as the most advantageous for control. However, the Contractor is responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations must show the results of the current test as well as the average results of the five most recent tests including the current test. Limits may be adopted for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, immediately resample and retest the coarse aggregate. If the second sample fails on any sieve, report that failure to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation is be considered out of control and must be reported to the Contracting Officer. Stop concreting and take immediate steps to correct the grading.

3.13.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, perform all tests for aggregate quality required by ASTM C33/C33M. In addition, after the start of concrete placement, perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Take samples for testing after the start of concrete placement immediately prior to entering the concrete mixer.

3.13.3 Scales, Batching and Recording

Check the accuracy of the scales by test weights prior to start of concrete operations and at least once every three months. Also conduct such tests as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week check the accuracy of each batching and recording device during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, do not operate the plant until necessary adjustments or repairs have been made. Immediately correct discrepancies in recording accuracies.

3.13.4 Batch-Plant Control

Continuously control the measurement of concrete materials, including cementitious materials, each size of aggregate, water, and admixtures. Adjust the aggregate weights and amount of added water as necessary to compensate for free moisture in the aggregates. Adjust the amount of air-entraining agent to control air content within specified limits.

Prepare a report indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during each day's plant operation.

3.13.5 Concrete Mixture

3.13.5.1 Air Content Testing

Perform air content tests when test specimens are fabricated. In addition, make at least two tests for air content on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Perform additional tests when excessive variation in workability is reported by the placing foreman or TPWD inspector. Conduct tests in accordance with ASTM C231/C231M for normal weight concrete. Plot test results on control charts. Submit the control charts weekly and make them readily available to the TPWD. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, perform a second test immediately. Average the results of the two tests and use this average as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. Plot the result of each test, or average as noted in the previous sentence, on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph AIR ENTRAINMENT. Set an upper warning limit and a lower warning limit line 1.0 percentage point above and below the average line, respectively. Set an upper action limit and a lower action limit line 1.5 percentage points above and below the average line, respectively. Plot the range between each two consecutive tests on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the materials or transportation methods cause air content loss between the mixer and the placement, take correlation samples at the placement site as required by the Contracting Officer, and the control the air content at the mixer as directed.

3.13.5.2 Air Content Corrective Action

Whenever points on the control chart for percent air reach either warning limit, immediately make an adjustment in the amount of air-entraining admixture batched. As soon as practical after each adjustment, make another test to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, recalibrate the admixture dispenser to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content is considered out of control and the concreting operation immediately halted until the air content is under control. Make additional air content tests when concreting is restarted.

3.13.5.3 Slump Testing

In addition to slump tests which are made when test specimens are fabricated during concrete placement/discharge, make at least four slump tests on randomly selected batches in accordance with ASTM C143/C143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, make additional tests when excessive variation in workability is reported by the placing foreman or TPWD inspector. Plot test results on control charts. Submit the control charts and make them readily available to the TPWD. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, immediately perform a second test. Average the results of the two tests and use this average as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Set limits on separate control charts for slump for each type of mixture. Set the upper warning limit at 1/2 inch below the maximum allowable slump specified in paragraph SLUMP in PART 1 for each type of concrete and, set an upper action limit line and lower action limit line at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. Plot the range between each consecutive slump test for each type of mixture on a single control chart for range on which an upper action limit is set at 2 inches. Take samples for slump at the mixer. However, the Contractor is responsible for delivering the concrete to the

placement site at the stipulated slump. If the materials or transportation methods cause slump loss between the mixer and the placement, take correlation samples at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed. 3.13.5.4 Slump Corrective Action Whenever points on the control charts for slump reach the upper warning limit, make an adjustment immediately in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, deliver no further concrete to the placing site until proper adjustments have been made. Immediately after each adjustment, make another test to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, halt the concreting operation immediately, and take appropriate steps to bring the slump under control. Make additional slump tests as directed.

3.13.5.5 Temperature

Measure the temperature of the concrete when compressive strength specimens are fabricated in accordance with ASTM C1064/C1064M. Report the temperature along with the compressive strength data.

3.13.5.6 Strength Specimens

Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter, nor less than once for each 5400 square feet of surface area for slabs or walls. Perform on additional sets of test specimens, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. Develop a truly random (not haphazard) sampling plan for approval by the Contracting Officer prior to the start of construction. Show in the plan that sampling is done in a completely random and unbiased manner.

- a. A set of test specimens for concrete with a 28-day specified strength in accordance with paragraph STRENGTH REQUIREMENTS in PART 2 consists of five specimens, two to be tested at 7 days, two at 28 days, and one cylinder held in reserve.
- b. A strength test is the average of the strengths of at least two 6 inch by 12 inch cylinders or at least three inch by 8 inch cylinders made for the same sample of concrete.
- c. Mold and cure test specimens in accordance with ASTM C31/C31M, and test in accordance with ASTM C39/C39M for test cylinders. Immediately report results of all strength tests to the Contracting Officer.
- d. Maintain quality control charts for individual strength "tests", ("test" as defined in paragraph STRENGTH REQUIREMENTS) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. Provide charts similar to those found in ACI 214R.

3.13.6 Inspection Before Placing

Inspect foundations, construction joints, forms, and embedded items in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. Report the results of each inspection in writing.

3.13.7 Placing

The placing foreman must supervise placing operations, determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman must not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators

are available. Do not continue placing if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, take immediate steps to improve temperature controls.

3.13.8 Cold-Weather Protection

At least once each shift and once per day on non-work days, inspect all areas subject to cold-weather protection. Note any deficiencies, correct, and report.

3.13.9 Mixer Uniformity

3.13.9.1 Stationary Mixers

Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, determine uniformity of concrete mixing in accordance with ASTM C94/C94M.

3.13.9.2 Truck Mixers

Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, determine uniformity of concrete mixing in accordance with ASTM C94/C94M. Select the truck mixers randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

3.13.9.3 Mixer Uniformity Corrective Action

When a mixer fails to meet mixer uniformity requirements, either increase the mixing time, change the batching sequence, reduce the batch size, or adjust the mixer until compliance is achieved.

3.13.10 Reports

Report all results of tests or inspections conducted, informally as they are completed and in writing daily. Prepare a weekly report for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, prepare daily reports of pertinent temperatures. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Confirm such reports of failures and the action taken in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

3.14 REPAIR, REHABILITATION AND REMOVAL

Before the TPWD accepts the structure and final payment is made, inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. Submit a report documenting these defects, which includes recommendations for repair, removal and/or remediation to the Contracting Officer for approval before any corrective work is accomplished.

3.14.1 Crack Repair

Prior to final acceptance, document and repair all cracks in excess of 0.02 inches wide. Submit the proposed method and materials to repair the cracks to the Contracting Officer for approval. Address the amount of movement expected in the crack due to temperature changes and loading.

3.14.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials.

Diamond grind concrete surfaces with weak surfaces less than 1/4 inch thick to remove the weak surface. Remove and replace surfaces containing weak surfaces greater than 1/4 inch thick, or mitigate in a manner acceptable to the Contracting Officer.

3.14.3 Failure of Quality Assurance Test Results

Do not proceed with proposed mitigation efforts to restore the service life until approved by the Contracting Officer.
END OF SECTION 03 30 00

SECTION 03 35 00
CONCRETE FINISHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 301	(2016) Specifications for Structural Concrete
ACI 301M	(2016) Metric Specifications for Structural Concrete
ACI 303R	(2012) Guide to Cast-In-Place Architectural Concrete Practice
ACI 305R	(2010) Guide to Hot Weather Concreting

ASTM INTERNATIONAL (ASTM)

ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
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1.3 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Product Data:	Recycled Content Products
Samples:	Field Test Panels Sample Wall Panels
Manufacturer's Instructions:	Dry Shake Finish

1.4 QUALITY ASSURANCE

1.3.1 Field Test Panels

Construct field test panels prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel is subject to the approval of the Contracting Officer, and, if not judged satisfactory, construct additional panels until approval is attained. Formed or finished surfaces in the completed structure must match the quality and appearance of the approved field example.

1.3.1.1 Sample Wall Panels

Construct one sample panel at least 4 feet by 5 feet and 6 inches thick to demonstrate Class A formed finish and a similar one for Class B formed finish. Each panel must include a full length and full width joint line and have at least two voids each at least 12 inches by 12 inches by 3 inches deep either impressed in the concrete as placed or chipped in the hardened concrete. After the concrete is 7 days old, patch the voids to demonstrate the effectiveness and the appearance of the Contractor's repair procedures.

PART 2 - PRODUCTS

Submit documentation indicating: distance between manufacturing facility and the project site, distance of raw material origin from the project site, percentage of post-industrial and post-consumer recycled content per unit of product and relative dollar value of recycled content products to total dollar value of products included in project. Provide submittals as specified in the subject Section.

PART 3 – EXECUTION

3.1 FINISHING FORMED SURFACES

- A. Forms, form materials, and form construction are specified in Section 03 11 13.00 10 STRUCTURAL CAST-IN-PLACE CONCRETE FORMING. Finish formed surfaces as specified herein. Unless another type of architectural or special finish is specified, leave surfaces with the texture imparted by the forms except that defective surfaces must be repaired.
- B. Maintain uniform color of the concrete by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish that is exposed to view or on which a special finish is required. The form panels used to produce the finish must be orderly in arrangement, with joints between panels planned in approved relation to openings, corners, and other features. Do not reuse forms if there is any evidence of surface wear or defects that would impair the quality of the surface.

3.1.1 Class A Finish

Class A finish is required for the retaining walls and outlet structure. Formed surfaces meet the requirements of ACI 301M ACI 301, surface finish SF-3.0.

3.1.2 Class B Finish

Class B finish is required for all other exposed concrete. Formed surfaces meet the requirements of ACI 301M ACI 301, surface finish SF-2.0.

3.1.3 Class C and Class D Finish

Class C finish is required for all non-exposed concrete. Formed surfaces meet the requirements of ACI 301M ACI 301, surface finish SF-1.0.

3.2 REPAIRS

Repair in accordance with ACI 301M ACI 301, Section 5.

3.3 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces must meet the requirements of paragraph TOLERANCES in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE. When tested as specified herein.

3.3.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed must not be less than 50 degrees F. In hot weather meet all requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE paragraphs HOT WEATHER REQUIREMENTS and PREVENTION OF PLASTIC SHRINKAGE CRACKING. In hot weather when the rate of evaporation of surface moisture, as determined by use of Figure 2.1.5 of ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour. Make provisions for windbreaks, shading, fog spraying, or wet covering with a light-colored material in advance of placement, and take such protective measures as quickly as finishing operations will allow. Float finish unformed surfaces that are not to be covered by additional concrete or backfill, with additional finishing as specified below, and true to the elevation indicated. Bring surfaces to receive additional concrete or backfill to the elevation indicated, properly consolidate, and leave true and regular. Unless otherwise indicated, evenly slope exterior surfaces for drainage. Where drains are provided, evenly slope interior floors to the drains. Carefully make joints with a jointing or edging tool. Protect the finished surfaces from stains or abrasions. Grate tampers or "jitterbugs" cannot be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing is not be permitted. If bleedwater is present prior to finishing, carefully drag off the excess water or remove by absorption with porous materials such as burlap. During finishing operations, take extreme care to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Remove and replace any slabs with surfaces which exhibit significant crazing. During finishing operations, check surfaces with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.3.2 Rough Slab Finish

In accordance with ACI 301M ACI 301, Section 5.

3.3.3 Float Finish

In accordance with ACI 301M ACI 301, Section 5.

3.3.4 Trowel Finish

In accordance with ACI 301M ACI 301, Section 5.

3.5 EXTERIOR SLAB AND RELATED ITEMS

3.5.1 Pavements

Immediately following the final consolidation of the surface, float the pavement longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, place and screed additional concrete, and operate the float until a satisfactory surface has been produced. Advance the floating operation not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, eliminate minor irregularities and score marks in the pavement

surface by means of long-handled cutting straightedges. Use straightedges that are 12 feet in length and operated from the sides of the pavement and from bridges. Equip a straightedge operated from the side of the pavement with a handle 3 feet longer than one-half the width of the pavement. Test the surface for trueness with a 12 foot straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one-half the length of the straightedge. Immediately fill depressions with freshly mixed concrete, strike off, consolidate, and refinish. Also strike and refinish projections above the required elevation. Continue the straightedge testing and finishing until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, give the surface of the pavement a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 3 to 5 feet wide and 2 feet longer than the pavement width shall be carefully pulled across the surface. Round edges and joints with an edger having a radius of 1/8 inch.

3.5.2 Sidewalks

Apply a lightly broomed finish, or as shown on plans.

3.5.3 Curbs and Gutters

Finish exposed surfaces using a stiff bristled brush.

END OF SECTION 01 32 00

SECTION 03 39 00

CONCRETE CURING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)	
ACI 301	(2016) Specifications for Structural Concrete
ACI 301M	(2016) Metric Specifications for Structural Concrete
ACI 308.1	(2011) Specification for Curing Concrete
ASTM INTERNATIONAL (ASTM)	
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete

1.3 SUBMITTALS

TPWD approval is required for submittals with a "TPWD" designation; submittals not having a "TPWD" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data	Curing Materials
SD-06 Test Reports	Testing and Inspection for CQC
SD-08 Manufacturer's Instructions	Curing Compound

1.4 DELIVERY, STORAGE, AND HANDLING

Store materials in such a manner as to avoid contamination and deterioration. Materials must be capable of being accurately identified after bundles or containers are opened.

PART 2 – PRODUCTS

2.1 CURING MATERIALS

Provide curing materials in accordance with ACI 301M ACI 301 Sections 5 and ACI 308.1 Section 2. Submit product data and manufacturer's instructions for concrete curing compound.

2.2 WATER

Provide water for curing that is fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali.

PART 3 – EXECUTION

3.1 CURING AND PROTECTION

Cure and protect concrete in accordance with ACI 301M ACI 301 Section 5.

3.2 TESTING AND INSPECTION FOR CQC

Perform the inspection and tests described below and, based upon the results of these inspections and tests, take the action required. Submit certified copies of laboratory test reports, including curing compound proposed for use on this project.

- A. Moist Curing Inspections – At least once each shift, and not less than twice per day on both work and non-work days, inspect all areas subject to moist curing. Note and record the surface moisture condition.
- B. Moist Curing Corrective Action – When a daily inspection report lists an area of inadequate curing, take immediate corrective action, and extend the required curing period for those areas by 1 day.
- C. Membrane Curing Inspection – Apply no curing compound until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, compute the rate of coverage in square feet/gallon, and note whether or not coverage is uniform.
- D. Membrane Curing Corrective Action – When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, spray the entire surface again.
- E. Sheet Curing Inspection – At least once each shift and once per day on non-work days, inspect all areas being cured using impervious sheets. Note and record the condition of the covering and the tightness of the laps and tapes.
- F. Sheet Curing Corrective Action – When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, promptly repair the tears and holes or replace the sheets, close the joints, and extend the required curing period for those areas by 1 day.

END OF SECTION 03 39 00

SECTION 04 85 20
STONE MASONRY VENEER & PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

This standard specification item includes:

- A. Cut stone veneer at exterior walls.
- B. Cut stone paving at exterior walkways.
- C. Metal anchors and accessories.
- D. Setting mortar and pointing mortar.

1.3 REFERENCES

- A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 1 997a.
- B. ASTM A 666 - Standard Specification for Annealed or Cold- Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 1996b.
- C. ASTM C 270 - Standard Specification for Mortar for Unit Masonry; 1997 a.
- D. ASTM C 568 - Standard Specification for Limestone Dimension Stone; 1996.
- E. ILI (HB) - Indiana Limestone Handbook; Indiana Limestone Institute of America, Inc.; 1992, 19th Edition.
- F. IMIA WC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.

1.4 SUBMITTALS

- A. Provide Digital PDF copy by email to Landscape Architect and Owner's Representative.
- B. Product Data: Provide data on stone units, mortar, and reinforcement.
- C. Samples: Submit two stone samples illustrating minimum and maximum stone sizes, color range, texture, and markings.
- D. Samples: Submit mortar color samples.

1.5 QUALITY ASSURANCE

- A. Stone Fabricator Qualifications: Company specializing in fabricating cut stone with minimum ten years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type required by this section, with minimum 5 years of documented experience.

1.6 MOCK-UP

- A. Construct stone walls and paving, as required by Drawings or directed by Landscape Architect which includes stone anchor accessories, corner condition, typical control joints, inlays, etc.
- B. Locate where directed.
- C. Mock-up may remain as part of the accepted Work at the contractor's risk.

1.7 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Protect stone from discoloration during storage on site.
- B. Provide ventilation to prevent condensation from forming on stone.

1.9 PROJECT CONDITIONS

- A. Sequence work to coordinate the installation of stone work with installation of adjacent construction.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: Comply with recommendations of IMIA WC (CW).

PART 2 - PRODUCTS

2.1 STONE

- A. Provide stone per Drawing specifications. Quarried, complying with ASTM C 568 Classification I – Low Density.
- B. Surface Texture: per Drawing specifications.
- D. Color: As per Drawing specifications or as approved by Landscape Architect.

2.2 MORTAR

- A. Setting Mortar: ASTM C 270, Type S.
- B. Pointing Mortar: ASTM C 270 Type M.

2.3 ACCESSORIES

- A. Wall Anchors & Ties: Formed steel wall strap, [12] gage, hot dip galvanized to ASTM A 123, Grade 55, for screw attachment to studs, with provision for vertical adjustment after attachment and triangulated ties of V4" diameter looped through anchor strap slots.
- B. Other Anchors in Direct Contact with Stone: ASTM A 666, Type 304, stainless steel, of sizes and configurations required for support of stone and applicable superimposed loads.
- C. Setting Buttons and Shims: Lead.
- D. Flashings: N/A

- E. Weeps: Polyethylene tubing, 1/4 inch diameter, as required or specified in Drawings.
- F. Back Coating: N/A
- G. Cleaning Solution: Type which will not harm stone, joint materials, or adjacent surfaces.

2.4 STONE FABRICATION - CUT

- A. Nominal Thickness: as indicated on Drawings.
- B. Nominal Face Size: as indicated on Drawings.
- C. Pattern and Coursing: as indicated on Drawings.
- D. Fabricate for 3/8 inch beds and joints.
- E. Bed and Joint Surfaces: Cut or sawn full square for full thickness of unit.
- F. Backs: Sawn or as indicated.
- G. Form stone corners to irregular joint profile. Clean jagged corners from stone in preparation for setting.
- H. Slope exposed top surfaces of stone and horizontal cast stone surfaces for shedding water.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that support work and site conditions are ready to receive work of this section. B. Verify that items built-in under other sections are properly located and sized.

3.2 PREPARATION

- A. Establish lines, levels, and coursing. Protect from disturbance.
- B. Clean stone prior to erection. Do not use wire brushes or implements which can mark or damage exposed surfaces.
- C. Clean sawn surfaces of rust stains and iron particles.
- D. Coat back surfaces not to be in contact with setting mortar with back coating material.
- E. Allow coating to cure.

3.3 INSTALLATION

- A. Install flashings of longest practical length and seal watertight to back-up. Lap end joints minimum 6 inches and seal watertight.
- B. Cut stone at site to produce clean faces.
- C. Size stone units to fit opening dimensions and perimeter conditions.
- D. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.
- E. Arrange stone pattern to provide color uniformity and minimize visual variations, and provide a uniform blend of stone unit sizes.
- F. Provide setting and pointing mortar.
 - 1. If water is lost by evaporation, re-temper mortar only within two hours after mixing.
 - 2. At ambient air temperature 80 degrees F and above, use mortar within two hours after mixing; at ambient air temperature below 50 degrees F, use mortar within two-and-one-half hours after mixing.
- G. Fill dowel holes in stone units with mortar.
- H. Arrange stone coursing in running bond with consistent joint width.
- I. Set stone in full mortar setting bed to fully support stone over bearing surface. Use setting buttons or shims to maintain correct joint width.

3.4 REINFORCEMENT AND ANCHORAGE

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place horizontal joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place joint reinforcement continuous in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Embed wall ties in masonry back-up to bond veneer to back-up at maximum 16 inches on center vertically and 36 inches on center horizontally.
- F. In addition, place wall ties at maximum 3 inches on center each way around perimeter of openings, within 12 inches of openings.

3.5 JOINTS

- A. Rake out mortar joints 5/8 to 3/4 inch and brush joints clean to accommodate pointing mortar, unless otherwise noted in Drawings (ex. Recessed joints, smear joints, etc.). Fill joints with pointing mortar.
- B. Pack mortar into joints and work into voids. Neatly tool surface to concave joint.
- C. At joints to be sealed, clean mortar out of joint before it sets. Brush joints clean.

3.6 ACCESSORIES

- A. Install weeps in vertical stone joints at 24 inches on center, horizontally; immediately above horizontal flashings, above shelf angles and supports. Do not permit mortar accumulation in cavity space.

3.7 CLEANING

- A. Remove excess mortar as work progresses, and upon completion of work.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

3.8 PROTECTION OF FINISHED WORK

- A. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

END OF SECTION 04 85 20

SECTION 050523.16

STRUCTURAL WELDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel
Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189 (2016) ASNT Standard for Qualification and
Certification of Nondestructive Testing
Personnel (ANSI/ASNT CP-105-2006)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2012) Standard Symbols for Welding,
Brazing and Nondestructive Examination

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)
Structural Welding Code - Steel

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet
Steel

AWS D1.4/D1.4M (2011) Structural Welding Code -
Reinforcing Steel

AWS D1.8/D1.8M (2016) Structural Welding Code—Seismic
Supplement

AWS D14.4/D14.4M	(2012) Specification for Welded Joints for Machinery and Equipment
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors
AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes
ASTM INTERNATIONAL (ASTM)	
ASTM E165/E165M	(2012) Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E709	(2015) Standard Guide for Magnetic Particle Examination

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Preconstruction Submittals	Welding Quality Assurance Plan
Product Data	Welding Procedure Qualifications
	Welder, Welding Operator, and Tacker Qualification
	Previous Qualifications
	Pre-Qualified Procedures
	Welding Electrodes and Rods
	Test Reports Nondestructive Testing
	Weld Inspection Log
Certificates	Certified Welding Procedure Specifications (WPS)
	Certified Brazing Procedure Specifications (BPS)
	Certified Procedure Qualification Records (PQR)
	Certified Welder Performance Qualifications
	(WPQ) Certified Brazers Performance
	Qualifications (BPQ)
	Certified Welding Inspector
	Nondestructive Testing Personnel

1.4 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding must record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the procedure qualification records for each type of welding being performed. Submission of the welder, welding operator, or tacker qualification test records is also required. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.4.1 General Requirements

Fabricate work in an AISC Certified Fabrication Plant, Category BU. Erect work by an AISC Certified Erector, Category CSE.

- a. For Structural Projects, provide documentation of the following:
 - (1) Component Thickness 3 mm 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.
 - (2) Component Thickness Less than 3 mm 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.
 - (3) Reinforcing Steel: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.4/D1.4M.
- b. For other applications, provide documentation of the following:
 - (1) Submit two copies of the Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) to TPWD for approval.
 - (2) Submit two copies of the Certified Welder Performance Qualifications (WPQ) and Certified Brazer Performance Qualifications (BPQ) to the Contracting Officer for approval within fifteen calendar days prior to any employee welding on the project material.
 - (3) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.4.2 Previous Qualifications

Welding procedures previously qualified by test in accordance with AWS D1.1/D1.1M, may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

- c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.4.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.4.4 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used within the applicable essential variables for welder qualification.

1.4.4.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.4.4.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.4.4.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as

evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

- d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability or there has been a gap greater than 6 months since he/she last used the process. In such a case, the tacker is required to pass the prescribed tack welding test.

1.4.5 Inspector Qualification

Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1. Submit qualifications for nondestructive testing personnel in accordance with the requirements of ANSI/ASNT CP-189 for Levels I or II in the applicable nondestructive testing method. Level I inspectors must have direct supervision of a Level II inspector.

1.4.6 Symbols and Safety

Use symbols in accordance with AWS A2.4, unless otherwise indicated. Follow safe welding practices and safety precautions during welding in conformance with AWS Z49.1.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

2.1.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (submitted for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and nondestructive testing; welding schedule; and other items deemed necessary by the attendees.

2.2 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, welding electrodes and rods, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator. Use E70 welding electrodes. Provide

welding equipment and materials that comply with the applicable requirements of AWS D1.1/D1.1M. Submit product data on welding electrodes and rods.

PART 3 - EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

- a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.
- b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 1 m 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Test 50% of CJP welds using ultrasonic testing per Table 6.2 of AWS D1.1/D1.1M. Randomly test 50% of all PJP and fillet welds or as indicated by magnetic particle or dye penetrant testing. Verify the welds conform to paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M ASTM E165/E165M, and ASTM E709. Submit a Welding Quality Assurance Plan and records of tests and inspections.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Submit all records of nondestructive testing.

3.3.1 Nondestructive Testing

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials

or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present. Submit all records of nondestructive testing in accordance with paragraph STANDARDS OF ACCEPTANCE.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds must meet the inspection requirements for the original welds.

END OF SECTION 052316.16

SECTION 05 52 00
METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 180	(2012; R 2017) Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail
AASHTO M 314	(1990; R 2013) Standard Specification for Steel Anchor Bolts

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel
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ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.3.8M	(1981; R 2005) Metric Hex Lag Screws
ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.22M	(1981; R 2017) Metric Plain Washers
ASME B18.6.1	(2016) Wood Screws (Inch Series)

ASME B18.6.3	(2013; R 2017) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)
ASME B18.6.5M	(2000; R 2010) Standard Specification for Metric Thread-Forming and Thread-Cutting Tapping Screws
ASME B18.6.7M	(1999; R 2010) Metric Machine Screws
ASTM INTERNATIONAL (ASTM)	
ASTM A108	(2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	(2017) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325M	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A36/A36M	(2014) Standard Specification for Carbon Structural Steel
ASTM A449	(2014) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A467/A467M	(2007; R 2012) Standard Specification for Machine Coil Chain
ASTM A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	(2018) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A512	(2006; R 2012) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A53/A53M	(2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A575	(1996; E 2013; R 2013) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM B221	(2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C514	(2004; R 2014) Standard Specification for Nails for the Application of Gypsum Board
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F3125/F3125M	(2015a) Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 898-1	(2013) Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel — Part 1: Bolts, Screws and Studs with Specified Property Classes — Coarse Thread and Fine Pitch Thread
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	(2001; R 2012) Pipe Railing Systems Manual
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1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings

1. Within 30 days of contract award, submit fabrication drawings to the Contracting Officer for the following items:
 - a. Iron and steel hardware
 - b. Steel shapes, plates, bars and strips
 - c. Steel railings and handrails
 - d. Anchorage and fastening systems
2. Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:
 - a. Structural-steel plates, shapes, and bars
 - b. Structural-steel tubing
 - c. Concrete inserts
 - d. Protective coating
 - e. Steel railings and handrails
 - f. Anchorage and fastening systems

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Shop Drawings

Fabrication Drawings

Iron and Steel Hardware

Steel Shapes, Plates, Bars and Strips

Product Data

Structural-Steel Plates, Shapes, and Bars

Structural-Steel Tubing

Cold-Finished Steel Bars

Hot-Rolled Carbon Steel Bars

Concrete Inserts

Protective Coating

Steel Railings and Handrails

Anchorage and Fastening Systems

Certificates

Welding Procedures

Welder Qualification

Manufacturer's Instructions

Installation Instructions

1.5 QUALITY CONTROL

A. Welding Procedures

1. Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

2. Submit results of welding procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

B. Welder Qualification

1. Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, conduct an immediate retest of two test welds and ensure that each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

PART 2 – PRODUCTS

2.1 FABRICATION

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning, treating, and applying surface finishes, including zinc coatings.

Provide railing and handrail detail plans and elevations at not less than 1 to 12 scale 1 inch to 1 foot. Provide details of sections and connections at not less than 1 to 4 scale 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of the size and thickness necessary to produce adequate strength and durability in the finished product for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and straight sharp edges. Ensure that all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form the exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use countersunk Phillips flathead screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

A. Steel Handrails

1. Fabricate joint posts, rail, and corners by one of the following methods:
 - a. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove-welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight-fitting interior sleeve not less than 6 inches long.
 - b. Railings may be bent at corners in lieu of jointing, provided that bends are made in suitable jigs and the pipe is not crushed.

B. Protective Coating

1. Provide protective primer paint and finishing paint as protective coating.
 - a. Prime Painting – Prime all metal surfaces with one coat Sherwin-Williams Red oxide Primer, B65RW552.
 - b. Finish Painting – Powder-coat or roll paint with Sherwin-Williams Industrial Coating or approved equal, color: SW4016 Corrugate Brown.

2.2 COMPONENTS

A. Structural Steel Plates, Shapes and Bars

1. Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to ASTM A36/A36M, unless otherwise noted.
2. Provide steel plates, to be bent or cold-formed, conforming to ASTM A283/A283M, Grade C.
3. Provide steel bars and bar-size shapes conforming to ASTM A36/A36M, unless otherwise noted.

B. Structural-Steel Tubing

1. Provide structural-steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

C. Fasteners

1. Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.
2. Provide standard hexagon-head bolts, conforming to ISO 898-1 ASTM A307, Grade A.

D. Steel Railings and Handrails

1. Provide steel handrails, including inserts in concrete, structural tubing conforming to ASTM A500/A500M, Grade A or B of equivalent strength.
2. Provide kickplates between railing posts where indicated and consisting of 4-millimeter 1/8 inch steel flat bars not less than 6 inches high. Secure kickplates as indicated.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Adjust stair railings and handrails before securing in place in order to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 5 feet on center. Plumb posts in each direction. Secure posts and rail ends to wall construction with one of the following:
 - 1. Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard-weight, steel pipe, not less than 6 inches long, and having an inside diameter not less than 1/2 inch greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom of the sleeve, with closure width and length not less than 1 inch greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, fill the annular space between the post and sleeve with non-shrink grout or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.
 - 2. Anchor posts in concrete by means of threaded anchor and mounting plate detail as shown on sheet C8.02. Provide 1/2-in diameter threaded anchors epoxy grouted into concrete with Hilti HIT-HY200 adhesive or approved equal. Cut ends of threaded anchor not permitted on the exposed end of the anchor. Exposed anchor ends shall be smooth and burr free.

3.2 INSTALLATION

- A. Submit manufacturer's installation instructions for the following products to be used in the fabrication of steel hand rail work:
 - 1. Structural-steel plates, shapes, and bars
 - 2. Structural-steel tubing
 - 3. Hot-rolled carbon steel bars
 - 4. Protective coating
 - 5. Steel railings and handrails
 - 6. Anchorage and fastening systems
- B. Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars, and strips used in accordance with the design specifications cited in this section.
- C. Steel Handrail – Install handrail in pipe sleeves embedded in concrete and filled with non-shrink grout or quick-setting anchoring cement with anchorage covered with standard pipe collar pinned to post or by base plates bolted into top of concrete retaining walls.
- D. Touchup Painting – Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

3.3 FIELD QUALITY CONTROL

- A. Field Welding – Ensure that procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with AWS D1.1/D1.1M.

END OF SECTION 05 52 00

SECTION 06 71 33

FIBERGLASS REINFORCED PLASTIC (FRP) LADDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. This Section includes, but is not limited to, new fiberglass reinforced plastic (FRP) ladder systems, including safety ladder cages, mounting systems and related accessories.

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN LADDER INSTITUTE (ALI)

ALI A14.3 (2008; R 2018) Ladders - Fixed - Safety Requirements

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP Z359.16 (2016) Safety Requirements for Climbing Ladder Fall Arrest Systems

ASTM INTERNATIONAL (ASTM)

ASTM D430 (2006; R 2012) Standard Test Methods for Rubber Deterioration - Dynamic Fatigue

ASTM D495 (1999; R 2004) Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

ASTM D638 (2014) Standard Test Method for Tensile Properties of Plastics

ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1148	(2013; R 2018) Standard Test Method for Rubber Deterioration—Discoloration from Ultraviolet (UV) or UV/Visible Radiation and Heat Exposure of Light-Colored Surfaces
ASTM D234	(2016) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D4000	(2016) Standard Classification System for Specifying Plastic Materials
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 101	(2018; ERTA 18-1; ERTA 18-2; ERTA 18-3; ERTA 18-4; TIA 18-1; TIA 18-2; TIA 18-3; TIA 18-4) Life Safety Code
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
29 CFR 1910.27	(Nov 2016) Scaffolds and Rope Descent Systems
29 CFR 1910.29	(Nov 2016) Fall Protection System and Falling Object Protection - Criteria and Practices
29 CFR 1926	Safety and Health Regulations for Construction
AMERICAN LADDER INSTITUTE (ALI)	
ALI A14.3	(2008; R 2018) Ladders - Fixed - Safety Requirements
AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)	
ASCE 7-16	(2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures
AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)	
ASSP Z359.16	(2016) Safety Requirements for Climbing Ladder Fall Arrest Systems
ASTM INTERNATIONAL (ASTM)	
ASTM D430	(2006; R 2012) Standard Test Methods for Rubber Deterioration - Dynamic Fatigue
ASTM D495	(1999; R 2004) Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics

ASTM D696	(2016) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C with a Vitreous Silica Dilatometer
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1148	(2013; R 2018) Standard Test Method for Rubber Deterioration—Discoloration from Ultraviolet (UV) or UV/Visible Radiation and Heat Exposure of Light-Colored Surfaces
ASTM D2344	(2016) Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D4000	(2016) Standard Classification System for Specifying Plastic Materials
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 101	(2018; ERTA 18-1; ERTA 18-2; ERTA 18-3; ERTA 18-4; TIA 18-1; TIA 18-2; TIA 18-3; TIA 18-4) Life Safety Code
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
29 CFR 1910.27	(NOv 2016) Scaffolds and Rope Descent Systems
29 CFR 1910.29	(Nov 2016) Fall Protection System and Falling Object Protection - Criteria and Practices
29 CFR 1926	Safety and Health Regulations for Construction

1.4 ADMINISTRATIVE REQUIREMENT

- A. Preinstallation Meetings - Within 30 calendar days of Contract Award, a preinstallation meeting will be scheduled by the Contracting Officer. Submit the following for review:
 1. Qualification of Manufacturer.
 2. Qualification of Engineer of Record.
 3. Manufacturer's Catalog Data.
- B. Include two copies of manufacturer's specifications, load tables, dimension diagrams, and anchor details for the following items:
 1. FRP Ladders, Fell Arrest System and Ladder Safety Cages.
 2. Anchorage Materials.
- C. Fabrication and Installation Drawings and Details.
 1. Include plans, elevations, sections, and details of FRP fabrications and their connections. Show anchorage and all accessory items.

2. Provide templates for anchors and bolts specified for installation under other Sections.
3. Provide structural analysis data complying with design loads, signed and sealed by the qualified professional engineer responsible for their preparation.

D. Manufacturer's Recommendations.

1. Provide shipping, handling, and erection procedures, along with instructions for care and maintenance after installation.

E. Manufacturer's Sample Warranty.

1.5 QUALITY CONTROL

A. Qualification of Manufacturer.

1. Fiberglass reinforced plastic (FRP) manufacturer is required to have a minimum of 10 years of experience in manufacturing FRP products.
2. A record of a minimum of five separate, similar installations within the last 5 years is required. Provide manufacturer's warranty for all FRP products against defects in material and workmanship for a minimum of 5 years.
3. Provide manufacturer's warranty for all FRP products against defects in material and workmanship for a minimum of 5 years. Manufacturer to provide evidence of ISO 9001-2000 standard certification.

B. Qualification of Engineer of Record.

1. Ensure that the Ladder Engineer of Record (ER) is currently licensed within the jurisdiction of the project.
2. Provide documentation that the Ladder Engineer of Record (ER) is approved, authorized, and currently licensed by the State of Texas, and has a minimum of 5 years of experience as an approved Engineer for manufacturers of similar ladder systems. Supply the names and locations of five projects of similar size and scope for which the ER has provided engineering calculations using the manufacturer's products submitted for this project within the previous 3 years. Provide ER-certified engineering calculations and sealed documents for:
 - a. Meeting ASCE 7-16 requirements in accordance with the International Building Code.
 - b. Fabrication and installation drawings and details.

1.6 DELIVERY, HANDLING, AND STORAGE

- A. Deliver all manufactured materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturers, clearly marked and identified relative to the complete system. Provide all adhesives, resins, and their catalysts and hardeners in clearly marked or noted crates or boxes. Store all manufactured materials in a dry indoor facility with a constant temperature range between 70 and 85 degrees F until they are required.

- B. Submit manufacturer's recommendations for shipping and handling. Handle all materials to prevent abrasion, cracking, chipping, twisting, or other deformations and other types of damage.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Ensure that all ladder side rails, rungs, mounting brackets, cage straps, and related safety rail system are FRP structural shapes manufactured to comply with or exceed the standards identified in this Section. Provide FRP ladders and ladder safety cages and anchorage materials, including cage hoops, brackets, and all other structural shapes composed of reinforced fiberglass components and resin in qualities, quantities, properties, arrangements, and dimensions as specified in the Contract Documents. Ensure that the complete assembly meets the minimum requirements of ASCE 7-16 and 29 CFR 1910.27.
- B. Design Requirements:
 - 1. Ensure that fiberglass reinforcement is a combination of continuous roving, continuous strand mat, bidirectional roving mat, and surfacing veil in sufficient quantities as required by the application, the physical properties, or both. Clearly identify components as specified in ASTM D4000. Submit documentation verifying structural integrity in relation to thermal expansion.
 - 2. Ensure that all finished surfaces of FRP items are smooth, resin-rich, and free of voids, dry spots, cracks, crazes or unreinforced areas. Provide a system that is completely covered with resin protection against wear, weathering, and damage from ultraviolet light. Submit ultraviolet testing (UV) results and documented protection with:
 - a. Integral UV inhibitors in the resin
 - b. A synthetic, resin-rich surfacing veil, meeting or exceeding the requirements of ASTM D1148.
 - 3. Provide FRP products that have a tested flame spread rating of 25 or less as specified in ASTM E84 Tunnel Test, with a ladder system meeting the minimum requirements of ASTM D430 and ASTM D495.
 - 4. Provide 316 stainless steel bolts for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, wall brackets to the ladder, and landing safety rails to the system. Mechanically attach all rungs to the ladder with 18-8 stainless-steel rivets, and chemically bond with resin.
 - 5. All ladder and cage components are to be integrally pigmented yellow. All wall and vertical rail base mount brackets are to be light gray.
- C. Performance Requirements
 - 1. Provide structural shapes in the ladder system meeting minimum longitudinal mechanical properties as follows:

Tensile Strength	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2,500,000 psi

Flexural Strength	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	1,800,000 psi
Flexural Modulus Full Section		2,800,000 psi
Short Beam Shear	ASTM D2344	4,500 psi
Shear Modulus-Transverse		450,000 psi
Coefficient of Thermal Expansion	ASTM D696	0.000008 in/in/F
Flame Spread	ASTM E84	25 or less

- a. Structural Performance of Ladders - Provide ladders capable of withstanding the effects of gravity loads as specified in ASCE 7-16 and the International Building Code, as well as loads and stresses within limits and under conditions specified in 29 CFR 1910.27 and ALI A14.3.
 - b. Provide ladders that to support a concentrated vertical load of 1200 pounds applied at mid-span of the rung.
2. Thermal Movements - Provide exterior metal fabrications that withstand thermal movements resulting from maximum change (range) between 120 degrees F, ambient, and 180 degrees F, material surface. Specifically, prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 3. Safety Performance of Ladders - Provide a ladder system that fully complies with NFPA 101, OSHA 29 CFR 1910.27, and ALI A14.3 for distance between rungs, cleats, and steps and for minimum clearances for cages and climbing space.

2.2 COMPONENTS

A. Ladders

1. Fabricate ladder side rails of a continuous pultruded, 1 3/4 inch square tube with a minimum wall thickness of 1/4 inch or greater. Fabricate ladder rungs to be 1 1/4 inch diameter pultruded structural shapes, continuously fluted to provide a nonslip surface. Rungs that are gritted as a secondary operation are not permitted. Fit the rungs in the centerline of the side rails.
2. Fabricate ladder walls and floor mounts from pultruded angles, 3/8 inch minimum thickness. Mechanically attach all ladder rungs to ladder side rails by use of stainless-steel rivets and a chemical bond of epoxy.
3. Protect all pultruded ladder components from ultraviolet (UV) attack by providing integral UV inhibitors in the resin and a synthetic surfacing veil to help produce a resin-rich surface.

B. Ladder Safety Cages

1. Provide primary hoops at the top and bottom of the safety cage, with spacing no more than 20 feet on center. Provide secondary intermediate hoops with spacing no more than 48 inches on center between primary hoops.
2. Ensure that safety cage vertical bars are 1 1/2 inches wide by 5/8 inch pultruded I-beam shapes and offer protection to workers from exposed hardware. Ensure that safety cage hoops and

brackets are manufactured by the open-mold hand-lay-up process. Ensure that all cage hoops are a minimum 3 inches wide by 1/4 inch thick.

C. Ladder Safety Devices (Climbing Ladder Arrest System)

1. Conform to 29 CFR 1910.29, Section 7 of ALI A14.3 and ASSP Z359.16. Install ladder safety devices on ladders over 20 feet long or more. The ladder safety systems must meet the design requirement of the ladders which they serve. The ladder safety system must be capable of sustaining a minimum static load of 1,000 pounds. The applied loads transferred to the climbing ladder mounting locations as a result of a fall shall be specified by the manufacturer of the climbing ladder fall arrest system. Each ladder safety system must allow the worker to climb up and down using both hands and does not require the employee continuously, hold, push, or pull any part of the system while climbing. The connection between the carrier or lifeline and the point of attachment to the body harness does not exceed 9 inches. The ladder safety system consists of a rigid or flexible carrier. Mountings for the rigid carriers are attached at each end of the carrier, with intermediate mountings spaced as necessary, along the entire length of the carrier. Mountings for flexible carrier are attached at each end of the carrier and cable guides for flexible carriers are installed at least 25 feet apart but not more than 40 feet apart along the entire length of the carrier. The design and installation of mountings and cable guides does not reduce the design strength of the ladder.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fabricated FRP work in accordance with the approved detail drawings and descriptive data for each item of fabricated FRP, in conformance with 29 CFR 1926, and as specified.
- B. Assemble and install ladder systems and all components in strict accordance with the manufacturer's assembly documentation. Seal cut or drilled surfaces in accordance with the manufacturer's instructions. Provide adequate ventilation during all drilling, cutting, and resin application procedures.
- C. Fabrication:
 1. Ensure that the design and layout of ladders Fall Arrest System and safety cages complies with ALI A14.3 and OSHA 29 CFR 1910.27. Ensure that all ladder rungs penetrate the tube side wall of the ladder rails. Provide ladder rung connections that are both chemically locking epoxy and mechanically locking rivets.
 2. Fully shop-assemble ladders. Test-assemble safety cages; drill and fit to ensure proper field assembly. Leave safety cage brackets attached with bolts to the ladder for shipping, but disassemble ladder cage components. Package and ship each set of cage components with each respective ladder.
 3. Field-attach hoops to the brackets. Seal all cut, machined edges, holes, and notches to provide maximum corrosion resistance. Coat all field-fabricated cuts in accordance with the manufacturer's instructions.
- D. Fastening to Construction-In-Place
 1. Provide anchorage devices and fasteners where necessary for fastening fabricated FRP items to construction-in-place. Provide threaded fasteners for concrete inserts embedded in cast-in-place

concrete; masonry anchorage devices and threaded fasteners for solid masonry and concrete-in-place; toggle bolts for hollow masonry and stud partitions; through-bolting for masonry and wood construction; lag bolts and wood screws for wood construction; and connections for structural steel.

3.2 CLOSEOUT ACTIVITIES

A. Manufacturer's Warranty

1. Submit 5 copies of manufacturer's warranty 30 calendar days before final inspection.

END OF SECTION 06 71 33

SECTION 31 05 19

GEOTEXTILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 MEASUREMENT

Measure the as-built surface area, covered by geotextile. Allowance will be made for geotextile in anchor and/or drainage trenches but no allowance will be made for waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor.

Unit of Measure: Per the schedule of values.

1.3 PAYMENT

Geotextile installed and accepted will be paid for in accordance with bid form unit, or as specified in construction documents. This unit cost will include the cost of materials, equipment, installation, testing, and other costs associated with placement of the geotextile.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4354	(1999; R 2009) Sampling of Geosynthetics for Testing
ASTM D4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D4533	(2011) Trapezoid Tearing Strength of Geotextiles
ASTM D4632	(2008) Grab Breaking Load and Elongation of Geotextiles

ASTM D4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011) Determining the Specification Conformance of Geosynthetics
ASTM D4833	(2007) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

US ARMY CORPS OF ENGINEERS (USACE)

COE CW02215 Method to Determine Percent Open Area
Grid Aperture Stability by In-Plane Rotation

1.5 SUBMITTALS

Submittals will be handled in accordance with the TPWD UGC.

PROCEDURES:

Product Data	Thread Manufacturing Quality Control Sampling and Testing
Samples	Quality Assurance Samples and Tests
Certificates	Geotextile

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle geotextile in accordance with ASTM D4873.

1.5.1 Delivery

Notify the TPWD ODR a minimum of 24 hours prior to delivery and unloading of geotextile rolls packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, immediately rewrap rolls with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.5.2 Storage

Protect rolls of geotextile from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, either elevate rolls off the ground or place them on a sacrificial sheet of plastic in an area where water will not accumulate.

1.5.3 Handling

Handle and unload geotextile rolls with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

1.6 DEFINITIONS

Minimum Average Roll Value (MARV): Property calculated as typical minus two standard deviations. Statistically, it yields a 97.7 degree of confidence that any sample taken during quality assurance testing will exceed value reported.

PART 2 - PRODUCTS

2.1 RAW MATERIALS

A minimum of 7 days prior to scheduled use, submit manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

The contractor shall provide the Engineer with a certificate stating the name of the manufacturer, product name, style number, chemical composition of the product and other pertinent information to fully describe the geosynthetic. The certification shall state that the furnished geosynthetic meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program.

The manufacturing facility shall be ISO 9001 registered.

2.1.1 Geotextile

Provide geotextile that is a non-woven pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material may also be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1 MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE			
PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
FABRIC WEIGHT	OZ/YD ²	10, MIN	Tex-616-J
PERMITTIVITY	1/SEC	0.5, MIN	ASTM D4491
TENSILE STRENGTH	LBS.	200, MIN	ASTM D4632
APPARENT OPENING SIZE	U.S. SIEVE	80-120	ASTM D4751
ELOGATION AT YIELD	PERCENT	20-100	ASTM D4632
TRAPEZOIDAL TEAR	LBS.	75, MIN	ASTM D4533

2.1.2 Thread

A minimum of 7 days prior to scheduled use, submit proposed thread type for sewn seams along with data sheets showing the physical properties of the thread. Construct sewn seams with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. A minimum of 7 days prior to scheduled use, manufacturer's quality control manual must be submitted. Documentation describing the quality control program shall be made available upon request. Perform manufacturing quality control sampling and testing in accordance with the manufacturer's approved quality control manual. At minimum, geotextile shall be randomly sampled for testing in accordance with ASTM D4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

Provide assistance to the TPWD ODR in the collection of quality assurance samples for quality assurance testing; assign 7 days in the schedule to allow for testing. Collect samples upon delivery to the site at the request of the TPWD's ODR. Identify samples with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. Discard the outer layer of the geotextile roll prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 3 feet long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

At the TPWD ODR's option, the Department will provide quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test

method ASTM D4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 31 20 00.

3.2.2 Placement

Notify the TPWD ODR a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, lay the geotextile with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

3.3.1 Overlap Seams

Continuously overlap geotextile panels a minimum of 12 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, lap the upper panel over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.3.2 Sewn Seams

Factory and field seams shall be continuously sewn. The stitch type used shall be a 401 locking chain stitch or as recommended by the manufacturer. For field and factory seams which are sewn, provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, the seams shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, provide samples of seams from both directions. Provide Quality Assurance seam samples to the TPWD at the request of the TPWD's ODR. Seam strength shall meet the minimum requirements specified in Table 1. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 18 inches of overlap.

3.4 PROTECTION

Protect the geotextile during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Use adequate ballast (e.g. sand bags) to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.5 REPAIRS

Repair torn or damaged geotextile. Clogged areas of geotextile shall be removed. Perform repairs by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Remove and replace geotextile rolls which cannot be repaired. Repairs shall be performed at no additional cost to the Department.

3.6 PENETRATIONS

Construct engineered penetrations of the geotextile by methods recommended by the geotextile manufacturer.

3.7 COVERING

Do not cover geotextile prior to inspection and approval by the TPWD ODR. Place cover soil in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the TPWD's ODR. Use equipment with ground pressures less than 7 psi to place the first lift over the geotextile. A minimum of 12 inches of soil shall be maintained between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section 31 00 00 EARTHWORK. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

END OF SECTION 31 05 19

SECTION 31 10 00

SITE CLEARING

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 SUMMARY

- A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping, or sealing site utilities.
7. Temporary erosion and sedimentation control.

1.3 MATERIAL OWNERSHIP

- A. Except for materials indicated to be salvaged, stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises as directed by Construction Manager.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction, unless otherwise shown on plans to be removed.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 01 5 639 "Temporary Tree and Plant Protection."

3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth **6 inches** in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water. Topsoil stockpile to be used in revegetation process.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 10 00

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 MEASUREMENT PROCEDURES

1.2.1 Excavation

The unit of measurement for excavation and borrow will be the cubic yard, in its original position, as computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock (except for piping trenches that is covered below), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade. Shrink or swelling factors will not be considered in determining the calculated quantities.

1.2.2 Topsoil Requirements

Separate excavation, hauling, and spreading or piling of topsoil and related miscellaneous operations will be considered subsidiary obligations of the Contractor, covered under the contract unit price for excavation except as noted.

1.3 PAYMENT PROCEDURES

Payment will constitute full compensation for all materials, labor, equipment, tools, supplies, and incidentals necessary to complete the work.

Unit of Measure: Per the schedule of values

1.3.1 Unclassified Excavation

Unclassified excavation will be paid for on a cubic yard basis, or as otherwise designated in construction documents, complete in place, including all labor, materials and equipment as necessary to satisfactory complete the work as required, with quantities as shown on the construction plans.

1.3.2 Unclassified Borrow

Unclassified borrow will be paid for on a lump sum basis, or as otherwise designated in construction documents, complete in place, including all labor, materials and equipment as necessary to satisfactory complete the work as required, with quantities as shown on the construction plans.

1.4 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.
- c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- d. Material character is indicated by the boring logs.
- e. Hard materials and rock will be encountered at varying depths below existing surface elevations. Contractor shall review boring logs and geotech report for further information.
- f. Borrow material in the quantities required is not available at the project site.

1.5 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances
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AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010) Structural Welding Code - Steel
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ASTM INTERNATIONAL (ASTM)

ASTM A 139/A 139M	(2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2010) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.6 DEFINITIONS

1.6.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 with plasticity index between 12 and 25 with greater than 40% by weight passing No. 200 sieve. Satisfactory materials for grading comprise stones less than 4 inches, except for fill material for pavements which comprise stones less than 3 inches in any dimension or as shown on plans.

1.6.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the TPWD's ODR when encountering any contaminated materials.

1.6.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic per ASTM D4318. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.6.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224.

1.6.5 Topsoil

Material in accordance with Section 32 92 19 Seeding

1.6.6 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 6 inch in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.6.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.6.8 Unstable Material

Unstable materials are too wet to properly support the concrete structure.

1.6.9 Porous Fill Material

Clean sand less than 5 percent fines.

1.6.10 Expansive Soils

Expansive soils are defined as soils that have a LL >50% and plasticity index equal to or greater than 25 when tested in accordance with ASTM D 4318.

1.7 SYSTEM DESCRIPTION

Subsurface soil boring logs are shown on the Geotechnical Report appended to the Technical Specifications. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.7.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.7.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.8 SUBMITTALS

Submittals will be handled in accordance with the TPWD UGC.

Preconstruction Submittals

Shoring and Sheet Piling Plan (Signed & Sealed by PE

Registered in Texas)

Dewatering work plan

Submit 15 days prior to starting work.

Test Reports

Borrow Site Testing

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for petroleum hydrocarbons, BTEX, PCBs and HW characteristics (including toxicity, ignitability, corrosivity, and reactivity). Backfill shall not contain concentrations of these analytes above the appropriate State and/or EPA criteria, and shall pass the tests for HW characteristics. Determine petroleum hydrocarbon concentrations by using appropriate State protocols. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5035/8260B. Perform complete TCLP in accordance with EPA SW-846.3-3 Method 1311. Perform HW characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples. Provide borrow site testing for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. For each borrow site, provide borrow site testing for HW characteristics from a composite sample of material, collected in accordance with standard soil sampling techniques. Do not bring material onsite until test results have been received and approved by the TPWD ODR.

PART 3 - EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 6 to 9 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings as approved by the TPWD ODR. Care must be taken to not strip off and remove any artifacts from the topsoil excavation sites. The TPWD reserves the right to preview the proposed topsoil excavation site for readily visible artifacts.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material

required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on the Drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, notify Engineer, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed, as approved by the Engineer.

3.2.3 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 1 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete.

3.2.4 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, remove such material 12-24 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the TPWD.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known TPWD-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a

utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the TPWD's ODR. Report damage of utility lines or subsurface construction immediately to the TPWD's ODR.

3.3 SHORING

Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

A Professional Geotechnical Engineer will provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. A written report shall be submitted, at least weekly, informing the Contractor and TPWD ODR of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems.

3.4 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory and wasted materials as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.5 GROUND SURFACE PREPARATION

3.5.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the TPWD ODR, in surfaces to receive fill or in excavated areas. Upon concurrence with Engineer, scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.5.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.6 UTILIZATION OF EXCAVATED MATERIALS

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.7 EMBANKMENTS

3.7.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 8- inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 95 percent laboratory maximum density at a moisture content between -1 percent to 3 percent of optimum moisture content. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.7.2 Subgrade Preparation

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the TPWD ODR. As specified in construction documents or upon concurrence with Engineer, the surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to plus 3 or minus 1 percent of optimum moisture to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.7.3 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade embankment with six passes of a dump truck loaded with 15 ton, or pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. Notify the TPWD ODR a minimum of 5 days prior to proof rolling. Proof rolling shall be performed in the presence of the TPWD ODR. Rutting or pumping of material shall be undercut as directed by the TPWD ODR and replaced with fill and backfill material. Bids shall be based on replacing existing material to an average elevation of 446.00 for areas to receive embankment fill.

3.7.4 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified.

3.7.4.1 Common Fill Placement

Provide for general site. Use satisfactory materials. Place in 8 inch uncompacted thickness lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.7.4.2 Porous Fill Placement

Provide as shown on plan on a compacted subgrade. Place in maximum 8 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.7.4.3 Borrow

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.7.5 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors operating at minimum 25 Hz, or other approved equipment. Compact each layer of the embankment to at least 95 percent of laboratory maximum density.

3.8 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turving materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.8.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until topsoil is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay topsoil until the subgrade has been checked and approved.

3.9 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 4 inches and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

3.10 TESTING

TPWD UGC and Special Specifications define contractor testing responsibilities.

- a. Determine field in-place density in accordance with ASTM D1556/D1556M.
- b. Calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the TPWD ODR. When test results indicate, as determined by the TPWD ODR, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.
- c. Perform tests on recompacted areas to determine conformance with specification requirements. A TPWD appointed registered professional civil engineer shall certify inspections and test results. These

certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.10.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.10.2 Porous Fill Material Testing

Test porous fill in accordance with ASTM C136/C136M for conformance to gradation specified in ASTM C33/C33M.

3.10.3 Density Test

<u>Material Type</u>	<u>Location of Material</u>	<u>Test Frequency</u>
Undisturbed native soil	Any	Two random tests on subgrade within construction line.
Embankments or borrow	Any	One test per lift and per 5,000 sq. ft
Native soil subgrade other than structures and parking	Any	One test per lift and per 2,500 sq. ft

3.10.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 2000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.11 DISPOSITION OF SURPLUS MATERIAL

Remove from TPWD property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber. Special Specifications define onsite TPWD disposal area and only at the direction of the TPWD ODR.

END OF SECTION 31 00 00

SECTION 31 36 00
GABIONS AND REVET MATTRESSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 DESCRIPTION

The work to be performed under this specification shall include furnishing, assembling, filling, and tying rock-filled wire mesh compartmented gabions and revet mattresses in accordance with the lines, grades, and dimensions shown on the Drawings or otherwise established in the field by the Engineer or designated representative. The type of construction (i.e. twisted woven mesh, welded mesh or both) and wire sizes [i.e. 13.5 gage (2.2 mm), 12 gage (2.7 mm) or 10 gage (3.4 mm)] shall be as defined in the Drawings or otherwise established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

PART 2 - MATERIALS

Gabions and revet mattresses shall be constructed of galvanized steel wire with polyvinylchloride (PVC) flexible coating. The gabions and revet mattresses shall be of the construction and sizes specified in the Drawings and shall meet the specifications presented herein. Unless otherwise specified in the Drawings or approved by the Engineer or designated representative, the gabions and revet mattresses may be constructed of either double twist woven mesh or welded wire mesh.

Gabions shall be furnished in the specified dimensions within a tolerance of ± 5 percent. Revet mattresses shall be furnished in the specified dimensions within a tolerance of (5 percent for the length and width and 10 percent for the height. For each individual gabion or revet mattress, the same mesh style shall be used for the base, front, ends, back, diaphragms and lid panels. Each gabion or revet mattress shall be manufactured and divided into cells of equal length, no greater than 3 feet (0.9 meter), by diaphragm panels.

2.1 Gabion and Revet Mattress Wire

Gabion wire shall be galvanized steel, Class 3 or A coating, soft temper conforming to ASTM A 641, and shall specifically meet the requirements given below for gabions (12 gage wire) and/or revet mattresses (13.5 wire gage) as called for in the Drawings. PVC coating of the wire may be fusebonded or extruded onto the wire. Galvanization of welded wire shall be performed either before or after welding.

Table 1: Requirements - Mesh Wire for Gabions and Revet Mattress Units

Characteristic	Gabions	Revet Mattresses
Wire Gage	12 gage	13.5 gage
Maximum Tensile Strength (ASTM 641)	70,000 psi (483 mPa)	75,000 psi (517 mPa)
Nominal Wire Diameter (ASTM A 641)	0.106 inch (2.7 mm)	0.0866 inch (2.2 mm)
Minimum Diameter (ASTM A 641, Table 3)	0.102 inch (2.6 mm)	0.0826 inch (2.9 mm)
Galvanizing, Zinc (ASTM A 641, Table 1)	0.80 oz/ft ² (245 gr/m ²)	0.70 oz/ft ² (215 gr/m ²)

2.2 Gabion Mesh

(A) Woven Mesh

Woven mesh shall be of a uniform nonraveling, double twist hexagonal pattern nominally of dimensions 3.25 inches by 4.5 inches (83 mm by 114 mm). Selvedge wire shall be 10 gage (nominal diameter of 3.4 mm).

(B) Welded Mesh

Mesh opening shall be nominally 3 inches by 3 inches (75 mm by 75 mm). Strength of welds shall meet the following requirements when tested in accordance with section 13.4 of ASTM A-974:

Table 2: Minimum Weld Strength Requirements

Type of Structure	Wire Size (Diameter)	Minimum Average Weld Shear Strength
	Gage (mm)	English Units (SI Units)
Gabions	12 (2.7)	472 lbf (2.10 kN)
Revet Mattress	13.5 (2.2)	292 lbf (1.30 kN)

(C) Manufacturing

Twisted wire mesh gabions shall be manufactured in conformance with ASTM A-975, while welded wire mesh gabions shall be manufactured in conformance with ASTM A-974.

2.3 Revet Mattresses

(A) Woven Mesh

Woven mesh shall be of a uniform nonraveling, double twist hexagonal pattern, nominally of dimensions 2.5" × 3.25" (64 mm by 83 mm). Selvedge wire shall be 12 gage (nominal diameter of 2.7 mm).

(B) Welded Mesh

Mesh opening shall be nominally 1.5" × 3.0" (38 mm by 76 mm). Strength of welds shall meet the requirements listed in Table 2 for 13.5 gage (2.2 mm) wire, when tested in accordance with section 13.4 of ASTM A-974:

(C) Manufacturing

Twisted wire mesh revet mattresses shall be manufactured in conformance with ASTM A-975, while welded wire mesh revet mattresses shall be manufactured in conformance with ASTM A-974.

2.4 PVC Coating

All wire used in fabrication of the gabions, revet mattresses and wiring operations during construction shall, after zinc coating, have a fusebonded or extruded coating of PVC. The coating shall be brown in color. The thickness shall be nominally 0.020 inch (0.5 mm), and shall not be less than 0.015 inch (0.38 mm) in thickness. It shall be capable of resisting deleterious effects of natural weather exposure, and immersion in salt water.

For PVC-coated welded wire fabric panel, cutting of the panels shall not be allowed closer than ¼ inch (1/8 inch (6 mm (3.18 mm) after fabrication in order to prevent exposure near the welds.

(A) Initial Properties:

1) Woven Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-975:

a) Specific Gravity:

The specific gravity as determined in accordance with ASTM D-792 shall be between 1.3 to 1.35.

b) Durometer Hardness:

The hardness as determined in accordance with ASTM D-2240 shall be between 50 to 60, Shore D.

c) Tensile Strength:

The tensile strength when tested in accordance with ASTM D-412 shall not be less than 2985 psi (20.6 mPa).

d) Modulus of Elasticity at 100% Elongation:

The Modulus of Elasticity when determined in accordance with ASTM D-412 shall not be less than 2700 psi (18.6 mPa).

e) Resistance to Abrasion:

The percentage loss in weight (mass) during abrasion testing in accordance with ASTM D-1242 shall be less than 12%.

f) Brittleness Temperature:

The brittleness temperature shall not be higher than 150F (-9.00C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 150F (80C) below the minimum temperature at which the gabion will be handled or filled.

2) Welded Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-974:

a) Specific Gravity:

The specific gravity as determined in accordance with ASTM D-792 shall be between 1.20 and 1.40.

b) Durometer Hardness:

The hardness as determined in accordance with ASTM D-2240 shall not be less than 75, Shore A.

c) Tensile Strength:

The tensile strength when tested in accordance with ASTM D-638 shall not be less than 2275 psi (15.7 mPa).

d) Modulus of Elasticity:

The Modulus of Elasticity when determined in accordance with ASTM D-638 shall not be less than 1980 psi (13.7 mPa).

e) Resistance to Abrasion:

The percentage loss in weight (mass) shall be less than 12 % during abrasion testing in accordance with ASTM D-1242, Method B, at 200 cycles, CSI-A abrader tape, 80 grit.

f) Brittleness Temperature:

The brittleness temperature shall not be higher than 150F (-9.00C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 150F (80C) below the minimum temperature at which the gabion will be handled or filled.

g) Adhesion:

The PVC coating on the wire shall adhere to the wire such that the coating breaks rather than separates from the wire, when tested in accordance with the PVC Adhesion Test described in Section 13.3 of ASTM A-974.

h) Mandrel Bend:

The PVC-coated wire, when subjected to a single 3600 bend at 00F (-180C) around a mandrel ten times the diameter of the wire, shall not exhibit breaks or cracks in the PVC coating.

(B) Performance Tests:

The PVC coating shall have the demonstrated ability to withstand the specified exposure testing.

1) Exposure to Salt Spray: The PVC shall show no effect after 3000 hours of salt spray exposure in accordance with ASTM Test Method B-117.

2) Exposure to Ultraviolet Rays:

The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3000 hours, using apparatus Type E and 145°F (63°C), when tested in accordance with ASTM Practice D-1499 and G-23.

(C) Properties After Exposure Tests:

After conclusion of the salt spray and exposure to ultraviolet light tests, the PVC shall not show cracks, blisters or splits, nor any noticeable change in color. In addition the PVC coating shall not show cracks or breaks after the wires are twisted in the fabrication of the mesh, nor shall there be any moisture intrusion under the PVC coating as a result of the test.

After completion of the exposure tests the following criteria shall also be met:

1) Woven Mesh:

- a) The Specific Gravity shall not change more than 6% of its initial value.
- b) The Durometer Hardness shall not change more than 10% of its initial value.
- c) The Tensile Strength shall not change more than 25% of its initial value.
- d) The Resistance to Abrasion shall not change more than 10% of its initial value.

2) Welded Mesh:

- a) The Specific Gravity shall not change more than 6% of its initial value.
- b) The Modulus of Elasticity shall not change more than 25% of its initial value.
- c) The Tensile Strength shall not change more than 25% of its initial value.
- d) The Resistance to Abrasion shall not change more than 10% of its initial value.

(D) Salt Spray Resistance for Fastener:

The fasteners for twisted mesh wire gabions and revet mattresses shall be subjected to Salt Spray Test of Test Method B-117 for a period of not less than 48 ±1 hour cycle length. After testing the fasteners, the selvedge, or mesh wire confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.

2.5 Stone

(A) Gabion Basket Stones

Stone fill shall be durable and of suitable quality to ensure permanence in the structure. The stone used to fill the gabion baskets shall be a clean, sound, and durable rock meeting the following requirements. It shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex411A for Rock RipRap shall not exceed 18 percent. The stone shall be well graded to produce a dense fill, angular in texture, while meeting the following gradation requirements:

Table 3: Gabion Stone Gradation Requirements

Sieve Size		Percent by Weight (Mass) % Passing Each Individual Sieve
US	(SI)	
8 Inch	(200 mm)	100
4 Inch	(100 mm)	0—5
3 Inch	(75 mm)	0

The minimum unit weight (unit mass) of a rockfilled gabion shall be 120 pcf [1.92 megagrams (mg) per cubic meter]. Verification of unit weight (mass) shall be performed when ordered, and by constructing a test gabion with materials supplied for construction with the same effort and method intended for production gabions.

(B) Revet Mattress Stone:

The stone used to fill the revet mattresses shall be as specified for gabions except that it shall have a maximum dimension of 5 inches (125mm) and a minimum dimension of 3 inches (75 mm). The majority of the stone shall be in the 3 to 4 inch (75 to 100 mm) range; cubical or rounded in shape. A tolerance of 5% shall be allowed on the upper and lower dimensions of the rock.

2.6 Connections

(A) Wire

Lacing wire and connecting wire shall be 13.5 gage [0.087 inch (2.20 mm)] PVC coated galvanized steel, Class 3, soft temper, conforming to ASTM A-641. During testing, any separation of 2 inches (50 mm) or more between connecting wires shall be considered as a failure.

(B) Spiral Binder for Welded Wire Mesh

Spiral binders shall consist of 0.106 inch (2.7 mm) PVC coated wire for the gabion and 0.087 inch (2.2 mm) PVC coated wire for the revet mattresses. Spiral binders shall have a 3.0 inch (75 mm) maximum separation between continuous successive loops (3 inch or 75mm pitch).

The binder shall be made of galvanized steel, Class 3, soft temper, conforming to ASTM A-641.

(C) Alternate Fasteners for Twisted Woven Mesh

Alternate fasteners, acceptable for use by the intended gabion basket manufacturer, may be submitted to the Engineer for consideration and approval prior to construction. The fasteners may consist of split ring or interlocking fasteners. Alternate fasteners systems shall produce a joint that meets the requirements of ASTM A-975, Section 7, Table 2.

2.7 Fastener System

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required for all vertical and horizontal connections for single- and multiple-basket joinings, as well as the number and size wires the fastener is capable of properly joining. The Contractor shall provide a description of a properly installed fastener, including test reports, drawings and/or photographs. Properly formed fasteners shall meet the requirements of ASTM A-974 for welded wire mesh or ASTM A-975 for twisted woven mesh.

(A) Each interlocking fastener shall be locked and closed.

(B) Each overlapping ring fastener shall be closed and the free ends shall overlap an average of 1 inch (25 mm).

(C) Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. In order to prevent unraveling, both ends of the spiral shall be crimped back around itself.

(D) Wire fasteners shall not be used to join more wires, or larger wires, than tested and approved for the application.

2.8 Panel to Panel Joint Strength

The minimum strength of the joined panels shall be as specified in Section 7.3 of ASTM A-974 for Welded wire panels or Section 7.3 of ASTM A-975 for twisted woven mesh.

2.9 Miscellaneous

Aggregate bedding, geotextiles or other materials shall conform to the requirements established on the Drawings.

2.10 Certificate of Compliance

The Contractor shall submit Certificates of Compliance for all materials proposed for use to the Engineer for review and approval one week prior to construction.

PART 3 – EXECUTION

3.1 Construction

Twisted wire mesh Gabion's and revet mattresses shall be supplied in the forms allowed in ASTM A-975, while welded wire mesh Gabion's and revet mattresses shall be supplied in a form allowed in ASTM A-974.

The Gabion/revet mattress manufacturer/supplier will be required to have a qualified representative on site at the start of gabion/revet mattress construction. The Contractor shall submit work experience documentation of the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the gabion construction.

Gabions and revet mattresses shall be constructed to the lines and grades shown on the Drawings. Individual or groups of gabions or revet mattresses, which deviate from line and grade, shall, at the direction of the Engineer or designated representative, be removed and replaced at no cost to the owner. Gabions or revet mattresses, which are constructed with bulges, and/or underfilled, loosely filled, or otherwise lacking a neat and compact appearance shall, at the direction of the Engineer or designated representative, be repaired/replaced at no cost to the owner. Underfilling of gabion/revet mattress corners to facilitate insertion of spirals shall not be permitted.

3.1 Foundation Preparation

The foundation shall be excavated to the extent shown on the Drawings or as directed by the Engineer or designated representative. All loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. The depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to a density at least equal to that of the adjacent foundation. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free draining materials.

Any buried debris protruding from the foundation that will impede the proper installation and detrimentally impact the final appearance of the gabion, shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to gabion or revet mattress placement, the prepared foundation surface shall be inspected and approved by the Engineer and no material shall be placed thereon until that area has been approved.

Placement of filter material and/or filter fabric shall be as shown on the Drawings or directed by the Engineer.

3.2 Gabion/Revet Mattress Basket Assembly

No work shall take place using PVC coated materials unless both the ambient air temperature and the temperature of the PVC materials are at least 15°F (8°C) above the brittleness temperature of the PVC materials.

Assembly of gabions and revet mattresses shall consist of shaping and tying each individual basket. Baskets shall be assembled by connecting all untied edges including diaphragms with lacing wire, spirals or approved

fasteners. The connections for the completed assemblies shall conform to the requirements of Section 7 of ASTM specifications A-974 (welded wire) and Section 7.3 and Table 2 of A-975 (double twisted).

Assembly of baskets, connection of baskets together and lid closures shall be accomplished in accordance with one of the following approved procedures:

(A) Lacing Wire:

Using lacing wire of appropriate length, secure one end of the wire onto the basket corner by looping and twisting the lacing wire together. Proceed along the joint by tying with double loops every other mesh opening at intervals not more than 6 inches (150 mm) apart, while pulling the basket elements tightly together. Secure the other end of the lacing wire again by looping and twisting the wire around itself.

(B) Spiral Binders for Welded Wire Mesh:

Spiral binders, meeting the minimum acceptance criteria of article 594S.2(6)(c) shall be screwed into position such that they pass through each mesh opening along the joint. To prevent unraveling, each end of the spiral binder shall be crimped back against itself.

(C) Alternate Fasteners for Twisted Woven Mesh:

Interlocking fasteners meeting the minimum acceptance criteria of article 594S.2(6)(c), shall be installed with, as a minimum, one interlocking fastener in every other opening.

Ring fasteners meeting the minimum acceptance criteria of 594S.2(6)(c), shall be installed with, as a minimum, one split ring fastener in every opening, having a minimum 1 inch (25 mm) total overlap and securing only the number and diameter of wires for which tested.

Placing of gabions and revet mattresses shall consist of installing baskets to the lines and grades shown on the Drawings. Gabions and revet mattresses shall be securely fastened to each adjoining unit along the vertical and top reinforced edges of all contact surfaces. Overlying rows of baskets shall be staggered appropriately. Empty sections stacked on a filled line of gabions and revet mattresses shall be securely fastened to the bottom unit along the front, back and ends.

Prior to the placement of rock, the baskets used in the front vertical exposed faces of retaining walls shall be aligned. To facilitate alignment, tension may be applied to empty units at the direction of the Engineer or designated representative.

3.3 Filling of Gabions and Revet Mattresses

The gabions and revet mattresses may be filled by machine, in maximum lifts of 12 inches (300 mm). The machine work shall be supplemented with handwork to avoid bulges and provide a compact mass with a minimum of voids. Care will be exercised so as not to damage the gabion/revet mattress elements or wire coating by limiting height of drop during filling to 3.0 feet (0.9 meter) for Gabions and 1.5 feet (0.5 meter) for revet mattresses. Undue deformation or bulging of the mesh shall be corrected prior to further stone filling. Where specified on the Drawings, select large stone shall be hand placed on vertical outside faces to achieve a desired neat appearance.

During placement, the depth of stone in any cell shall not exceed the depth in an adjoining cell by more than one foot (300 mm). Stone smaller than the mesh opening found against vertical faces shall be removed.

Two connecting wires in each direction for end units and two parallel connecting wires perpendicular to the exposed face for exposed face units shall be installed at every 12 inch (300 mm) lift. The connecting wires shall loop around two mesh openings, and the ends of wires shall be securely twisted with a minimum of three twists after looping. Prefabricated connecting wire may be used in lieu of connecting wire.

Connecting wires associated with 18inch (450 mm) gabions shall be installed when and as specified on the Drawings or as recommended by the gabion/revet mattress manufacturer.

The gabion or revet mattress unit shall be overfilled by 1½ to 2 inches (37.5 to 50 mm) and the lid shall be bent and stretched until it meets the perimeter edges of the front and end panels. The stretching shall be accomplished using an approved lid closing tool in order to prevent damage to the PVC coating. Crow bars or similar single point leverage devices will not be allowed. The lid shall then be securely tied with lacing wire, spirals or approved fasteners to the fronts, ends and diaphragms. Excessive deformation of the lid panel to facilitate closing of a bulging gabion or revet mattress will not be permitted.

All backfill shall be placed and compacted in sequence with the filling of the baskets; however, care shall be exercised in compacting the fill behind a single row of baskets since excessive compaction effort can displace the gabions/revet mattresses from the desired alignment.

Gabion or revet mattress units may be cut or shaped to fit odd length or odd shaped areas. They shall be cut at least 6" to 8" (150 mm to 200 mm) larger than the opening to allow sufficient material for overlap and lacing. All edges or faces formed in this manner shall be adjusted to present a finished and pleasing appearance.

At all times, care shall be taken to turn all loose and projecting ends of wire into the gabion units to prevent injury.

PART 4 - Quality of Work

Wire of proper grade and quality, when fabricated and installed in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished properly, as determined by visual inspection, and shall conform to this specification.

PART 5 - Measurement

Measurement of acceptable "Gabions and Revet Mattresses", complete in place, will be made on the basis of volume determined by the actual length, width and height.

PART 6 - Payment

The Gabion and revet mattress quantities, measured as described above, will be paid for at the unit bid prices per cubic yard (cubic meter: 1 cubic meter equals 1.308 cubic yards) of the various types indicated. The price shall include full compensation for furnishing, hauling and placing all materials, including filter fabric, wire containers, connectors, reinforcement stones and backfill; for all labor, tools, equipment and incidentals needed to complete the work.

Excavation and all subgrade preparation required for shaping the foundation for the wire containers shall be included in the unit bid price for "Gabions and Revet Mattresses".

End Section 31 36 00

SECTION 31 37 00

RIPRAP, BOULDERS, AND BEDDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICE

Payment for Rock Riprap, Rock Riprap Bedding and Ledge Rock shall be full compensation for preparation of subgrade, furnishing, installing, backfill, tools, labor and other incidentals to complete the work.

Unit of Measure: Per the schedule of values.

1.3 SUMMARY

- A. The WORK includes excavation, grading, and installation of riprap, boulders, ledge rock, soil riprap, void-filled riprap, and bedding placed at the locations shown on the plans. The materials to be used and the construction of such structures shall be as specified herein.

1.4 REFERENCES

- A. The following is a list of standard which may be referenced in this section:

- 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. T85, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate.
 - b. T96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - c. T103, Standard Method of Test for Soundness of Aggregates by Freezing and Thawing.
 - d. T104, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
 - e. T248, Reducing Field Samples of Aggregate Test Size

2. ASTM International (ASTM): D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))

1.5 RELATED SECTIONS

A. The following is a list of specifications, which may be related to this section:

1. Section 01 50 00 Temporary Facilities and Controls
2. Section 01 57 23 Temporary Stormwater Controls
3. Section 31 20 00 Earthwork

1.6 SUBMITTALS

A. Contractor shall cooperate with Engineer in obtaining and providing samples of all specified materials.

B. Contractor shall submit certified laboratory test certificates for all items required in this section.

PART 2 – PRODUCTS

2.1 MATERIALS

A. RIPRAP

1. Riprap used shall be the size indicated in the drawings and shall conform to Table 1

Table 1: Rock Riprap Gradation Table							
Diameter D50 (in)	D15 (in)		D50 (in)		D85 (in)		D100 (in)
	Min	Max	Min	Max	Min	Max	Max
9	5.5	7.8	8.5	10.5	11.5	14	18
15	9.2	13	14.5	17.5	19.5	23	30
18	11	15.5	17	20.5	23.	27.5	36

2. The riprap designation and total thickness of riprap shall be as shown on the plans. The maximum stone size shall not be larger than the thickness of the riprap.

3. Neither width nor thickness of a single stone of riprap shall be less than one-third (1/3) of its length.

4. The specific gravity of the riprap shall be two and one-half (2.5) or greater.

5. Riprap specific gravity shall be according to the bulk-saturated, surface-dry basis, in accordance with AASHTO T85.

6. The bulk density for the riprap shall be 1.3 ton/cy or greater.

7. The riprap shall have a percentage loss of not more than forty percent (40%) after five hundred (500) revolutions when tested in accordance with AASHTO T96.

8. The riprap shall have a percentage loss of not more than ten percent (10%) after five (5) cycles when tested in accordance with AASHTO T104 for ledge rock using sodium sulfate.

9. The riprap shall have a percentage loss of not more than ten percent (10%) after twelve (12) cycles of freezing and thawing when tested in accordance with AASHTO T103 for ledge rock, procedure A.

10. Rock shall be free of calcite intrusions.

11. Rock shall be 'Native Brown Sandstone' similar in composition, color and character of historic CCC sandstone used at Buescher and Bastrop State Parks. Limestone is not permitted. (Representative Picture Below)



12. Native Brown Sandstone available at Texas Aggregates, 421 Old Perkins Road, Bastrop, Texas 78602. 512-303-4215. Other suppliers pending approval of matching in-situ sandstone.

13. Color

a. The color of the riprap shall be approved by Engineer and Construction Manager prior to delivery to the site.

b. The color of the riprap shall be consistent on the entire project and shall match the color of rock to be used for all other portions of the work.

B. BOULDERS

1. Boulders used shall be the size designated on the plans.

2. Boulder specific gravity shall be two and one-half (2.5) or greater.

3. Boulder specific gravity shall be according to the bulk-saturated, surface-dry basis, in accordance with AASHTO T85.

4. The bulk density for the boulder shall be 1.3 ton/cy or greater.

5. The boulders shall have a percentage loss of not more than forty percent (40%) after five hundred (500) revolutions when tested in accordance with AASHTO T96.

6. The boulders shall have a percentage loss of not more than ten percent (10%) after five (5) cycles when tested in accordance with AASHTO T104 for ledge rock using sodium sulfate.

7. The boulders shall have a percentage loss of not more than ten percent (10%) after twelve (12) cycles of freezing and thawing when tested in accordance with AASHTO T103 for ledge rock, procedure A.

8. Rock shall be free of calcite intrusions.

9. Rock shall be 'Native Brown Sandstone' similar in composition, color and character of historic CCC sandstone used at Buescher and Bastrop State Parks. Limestone is not permitted.

10. Color:

a. The color of the boulders shall be approved by Engineer and Construction Manager prior to delivery to the site.

b. The color of the boulders shall be consistent on the entire project and shall match the color of rock to be used for all other portions of the work.

C. LEDGE ROCK

1. Ledge rock shall be the size designated on the plans.

2. Ledge rock shall be of natural irregular shape with a rough surface on all edges to provide a natural aesthetic. No edges of the ledge rock shall be saw cut.

3. Top and bottom shall be approximately parallel so that they are stackable.

4. Ledge rock shall be relatively uniform in height (minimum dimension) and within 15% of the dimensions specified.

5. The length may vary, but should be greater than or equal to two times the height dimension.

6. The width dimension shall be relatively uniform and within 15% of the dimension specified.

7. Blocks shall be comprised of solid rock without excessive fractures, spalls, or weak layers to achieve these dimensions.

8. Ledge rock dimension of 12"(H) x 24"(L) x 18" (W) weighing approximately 0.3 ton each.

9. Rock shall be 'Native Brown Sandstone' similar in composition, color and character of historic CCC sandstone used at Buescher and Bastrop State Parks. Limestone is not permitted.

D. BEDDING

1. Riprap bedding shall consist of a two-stage bedding. Upper stage consisting of a D50=2-in stone to a depth of four inches and a lower stage consisting of a D50=0.25-in stone to a depth of two inches.

2. Gradation for granular bedding upper stage shall conform to Table 2.

3. Gradation for granular bedding lower stage shall conform to Table 3.

3. Granular bedding designation and total thickness of bedding shall be as shown on the plans.

4. Granular bedding shall meet the same requirements for specific gravity, absorption, abrasion, sodium sulfate soundness, calcite intrusions, and freeze-thaw durability as required for riprap.

- a. Broken concrete asphalt pavement or sledge, shall not be acceptable for use in the work. Rounded river rock is not acceptable unless specifically designated on the plans.
- b. The requirements for the wear test in AASHTO T96 shall not apply.

Table 2 - Upper Stage Bedding Gradation (C-33 Coarse Aggregate Size No.2)	
Sieve	Percent Passing
3"	100
2 ½"	90-100
2"	35-70
1 ½"	0-15
¾"	0-5

Table 3 - Lower Stage Bedding Gradation (C-33 Coarse Aggregate Size No.7)	
Sieve	Percent Passing
¾"	100
1/2"	90-100
3/8"	40-70
No. 4	0-15
No. 8	0-5

PART 3 – EXECUTION

3.1 PREPARATION

A. Channel slope, bottom, or other areas that are to be protected with riprap, or boulders shall be free of brush, trees, stumps, and other objectionable material and be graded to a smooth compacted surface as shown on the plans.

B. Contractor shall excavate areas to receive riprap to the subgrade as shown on the plans accounting for granular bedding.

C. Subgrade materials shall be stable.

D. Additional Compaction:

1. Additional compaction shall not be required unless specified by Engineer.
2. When subgrade is built up with embankment material it shall be compacted to ninety five percent (95%) maximum density (ASTM D698).

E. Bedding

1. After an acceptable subgrade is established, bedding shall be immediately placed and leveled to the specified elevation on the plans.
2. Immediately following the placement of the bedding material, the riprap shall be placed.

3. If bedding material is disturbed for any reason, it shall be replaced and graded at Contractor's expense.

4. Contamination:

a. In-place bedding materials shall not be contaminated with soils, debris or vegetation before the riprap is placed.

b. If contaminated, the bedding material shall be removed and replaced at Contractor's expense.

3.2 PLACEMENT

A. RIPRAP

1. Following acceptable placement of granular bedding, riprap placement shall commence as follows:

a. Machine Placed Riprap:

1) Riprap shall be placed on the prepared slope or channel bottom areas in a manner which will produce a reasonably well graded mass of stone with the minimum practicable percentage of voids.

2) Riprap shall be machine placed, unless otherwise stipulated in the plans or specifications.

3) It is the intent of these specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Unless otherwise authorized by Engineer, the riprap protection shall be placed in conjunction with the construction of embankment or channel bottom with only sufficient delay in construction of the riprap protection, as may be necessary, to allow for proper construction of the portion of the embankment and channel bottom which is to be protected,

b. Slope Placement:

1) When riprap is placed on slope, placement shall commence at the bottom of the slope working up the slope.

c. The entire mass of riprap shall be placed on either channel slope or bottom so as to be in conformance with the required gradation mixture and to line, grade, and thickness shown on the plans.

d. Riprap shall be placed to full course thickness at one operation and in such a manner as to avoid displacing the underlying bedding material. Placing of riprap in layers, or by dumping into chutes, or by similar methods shall not be permitted.

e. All material used for riprap protection for channel slope or bottom shall be placed and distributed such that there shall be no large accumulations of either the larger or smaller sizes of stones. Some hand placement may be required to achieve this distribution.

- f. The basic procedure shall result in larger materials flush to the top surface with faces and shapes arranged to minimize voids, and smaller material below and between larger materials.
- g. Surface grade shall be a plane or as indicated, but projections above or depressions under the finished design grade by more than ten percent (10%) of the rock layer thickness shall not be allowed.
- h. Smaller rock shall be securely locked between the larger stone. It is essential that the material between the larger stones shall not be loose or easily displaced by flow or by vandalism.
- i. The stone shall be consolidated by the bucket of the backhoe or other means that fill cause interlocking of the material.
- j. All rock is to be placed in a dewatered condition beginning at the toe of the slope or other lowest point.
- k. Contractor shall maintain the riprap protection until accepted. Any material displaced for any reason shall be replaced to the lines and grades shown on the plans at no additional cost to Owner. If the bedding materials are removed or disturbed, such material shall be replaced prior to replacing the displaced riprap.

2. Hand Placed Riprap:

- a. Hand placed riprap shall be performed during machine placement of riprap and shall conform to all the requirements of Part 2 above.
- b. Hand placed riprap shall also be required when the depth of riprap is less than two (2) times the nominal stone size, or when required by the plans or specifications.
- c. After the riprap has been placed, hand placing or rearranging of the individual stones by mechanical equipment shall be required to the extent necessary to secure a flat uniform surface and the specified depth of riprap, to the lines and grades as shown on the plans.

B. BOULDERS AND LEDGE ROCK

- 1. Following excavation and acceptance of subgrade by Engineer boulder or ledge rock placement shall commence as follows:
 - a. Boulders shall be placed on the prepared subgrade in a manner which will minimize voids.
 - b. Voids between boulders exceeding 4-inches shall be chinked.

3.3 REJECTION OF WORK AND MATERIALS

- A. Engineer will reject placed riprap, boulders, and bedding that do not conform to this section. Contractor shall immediately remove and re-lay the riprap, boulders, and bedding to conform to the contract documents.
- B. Riprap, boulders and bedding that do not conform to this section shall be rejected, whether delivered to the job site of placed.

- C. Rejected riprap, boulders and bedding shall be removed from the project site by contractor at contractor's expense.

END OF SECTION 31 37 00

SECTION 32 12 13

BITUMINOUS CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICES

There are no bid items for bituminous concrete pavement. Contractor is responsible for repairing damage to pavement resulting from construction activities in accordance with this section at no additional cost to the department.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 230 (1968; R 2000) Determining Degree of Pavement Compaction
of Bituminous
Aggregate Mixtures

AASHTO T 30 (2010) Standard Method of Test for
Mechanical Analysis of Extracted Aggregate

ASTM INTERNATIONAL (ASTM)

ASTM D 1559 (1989) Resistance to Plastic Flow of
Bituminous Mixtures Using Marshall
Apparatus

ASTM D 2172 (2005) Quantitative Extraction of Bitumen from Bituminous
Paving Mixtures

ASTM D 2950 (2009) Density of Bituminous Concrete in
Place by Nuclear Methods

U.S. GREEN BUILDING COUNCIL (USGBC)

1.4 SUBMITTALS

The following shall be submitted in accordance with TPWD UGC:

Product Data
BITUMINOUS CONCRETE PAVEMENT

Aggregate;
1 of 6

32 12 13

Samples	Asphalt cement; Uncompacted mix
Test Reports	Pavement cores Trial batch reports

Mix design
Asphalt concrete
Density
Thickness
Straightedge test

Submit reports for testing specified under paragraph entitled "Field Quality Control."

Certificates	Asphalt mix delivery record Asphalt concrete and material sources
--------------	--

Obtain approval of the Contracting Officer for materials and material sources 2 days prior to the use of such material in the work.

Asphalt concrete
Curbs
Guard (Guide) rails
Median barriers
Traffic signs
Submit certificates, signed by the producer, that paving materials and incidental construction items conform to specification requirements.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

Provide work and materials in accordance with applicable requirements of TxDOT Specifications. Sections and Paragraphs 334 and 340 mentioned herein refer to those specifications. Paragraphs in TxDOT Specifications entitled "Quantity and Payment" "Method of Measurement" and "Basis of Payment" shall not apply.

1.5.2 Modification of References

Where term "Engineer" is used in TxDOT Specifications it shall be construed to mean Contracting Officer.

1.5.3 Mix Delivery Record Data

Record and submit the following information to each load of mix delivered to the job site. Submit within one day after delivery on TPWD-furnished forms:

- a. Truck No:
- b. Time In:
- c. Time Out:
- d. Tonnage and Discharge Temperature:
- e. Mix Type:
- f. Location:

- g. Stations Placed:

1.5.4 Trial Batch

Submit current bituminous design reports for all mix types proposed for use on the project.

1.5.5 Mix Design

Submit results of laboratory tests performed on each mix design. Testing shall have been accomplished not more than one year prior to date of material placement.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not produce or place bituminous concrete when the weather is rainy or foggy, when the base course is frozen or has excess moisture, or when the ambient temperature is less than 40 degrees F in the shade away from artificial heat.

PART 2 - PRODUCTS

2.1 ASPHALT CONCRETE

Provide asphalt concrete in accordance with the applicable requirements of the TxDOT Specifications, except where specified otherwise. Recycled asphalt pavement material may be used as permitted by TxDOT Specification Section 340.2.7. Unit of Measure: Per Schedule of Values.

2.2 SUBBASE

TxDOT Specifications, materials for construction of the subbase shall be in accordance with Section 247, paragraph 247.2 and Section 276.2. Unit of Measure: Per Schedule of Values.

2.3 BASE COURSE

TxDOT Specifications, materials for construction of the base course shall be in accordance with Section 340, paragraph 340.2 and 340.4, Type B. Unit of Measure: Per Schedule of Values.

2.4 SURFACE COURSE

TxDOT Specifications, materials for construction of the surface course shall be in accordance with Section 340, paragraph 340.2 and 340.4, Type D. Unit of Measure: Per Schedule of Values.

2.5 PRIME COAT

TxDOT Specifications, materials for construction of the surface course shall be in accordance with Section 310, paragraph 310.2. Unit of Measure: Per Schedule of Values.

2.6 TACK COAT

TxDOT Specifications, materials for construction of the surface course shall be in accordance with Section 340, paragraph 340.2. Unit of Measure: Per Schedule of Values.

2.7 CURBS AND GUTTERS

TxDOT Specifications, materials for construction of curbs and gutters shall be in accordance with Section 529, paragraph 529.2. Concrete is specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Unit of Measure: Per Schedule of Values.

2.8 TRAFFIC SIGNS

TxDOT Specifications provide traffic signs in accordance with Section 644, paragraph 644.2. Unit of Measure: Per Schedule of Values.

2.9 METAL BEAM GUARD FENCE

TxDOT Specifications, materials for construction of metal beam guard fence and guardrail end treatments shall be in accordance with Section 540, paragraph 540.2 and Section 544, paragraph 544.2. Unit of Measure: Per Schedule of Values.

2.10 RETROREFLECTORIZED PAVEMENT MARKINGS

TxDOT Specifications provide retroreflectORIZED pavement markings in accordance with Section 666, paragraph 666.2, Type II marking materials, “traffic paint”. Unit of Measure: Per Schedule of Values.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 Excavation and Filling

Excavation and filling to establish elevation of subgrade is specified in Section 31 00 00 EARTHWORK.

3.2 CONSTRUCTION

Provide construction in accordance with the applicable requirements of the TxDOT Specifications, except where indicated or specified otherwise.

3.2.1 Subgrade

TxDOT Specifications, preparation of subgrade shall be in accordance with, Section 204 (Sprinkling), Section 210 (Rolling), Section 216 (Proof Rolling), and Section 31 20 00 EARTHWORK. Verify compacted subgrade, granular base, or stabilized soil is acceptable and ready to support paving and imposed loads.

3.2.2 Subbase

TxDOT Specifications, methods of construction of the subbase shall be in accordance with Section 247, Section 251, Section 276, and Section 31 20 00 EARTHWORK.

3.2.3 Base Course

TxDOT Specifications, methods of construction of the base course shall be in accordance with Section 340 and Section 341.

3.2.4 Surface Course

BITUMINOUS CONCRETE PAVEMENT

TxDOT Specifications, methods of construction of the surface course shall be in accordance with Section 340 and Section 341. See also Sections 300 and 310 for Tack Coat and Prime Coat respectively. Placement will not be permitted unless the Contractor has a working asphalt thermometer on site.

3.2.5 Curbs and Gutters

TxDOT Specifications, methods of construction of curbs and gutters shall be in accordance with Section 529, paragraph 529.3.

3.2.6 Traffic Signs

TxDOT Specifications install traffic signs in accordance with Section 644 Small roadside sign assemblies.

3.2.7 Retroreflectorized pavement markings

TxDOT Specifications, methods of construction of pavement marking shall be in accordance with Section 666, paragraph 666.4.

3.2.8 Metal Beam Guard Fence

TxDOT Specifications install metal beam guard fence in accordance with Section 540.

3.3 FIELD QUALITY CONTROL

Sample shall be taken by Contractor as specified herein. Contractor shall replace pavement where sample cores have been removed. Submit 2 pavement cores when using the in-place nuclear density method.

3.3.1 Sample and Core Identification

Place each sample and core in a container and securely seal to prevent loss of material. Tag each sample for identification. Tag shall contain the following information:

- a. Contract No.
- b. Sample No.
- c. Quantity
- d. Date of Sample
- e. Sample Description
- f. Source/Location/Stations Placed/depth below the finish grade
- g. Intended Use
- h. Thicknesses of various lifts placed

3.3.2 Testing

3.3.2.1 Bituminous Mix Testing

Take two samples per day per mix type at plant or from truck. Test uncompacted mix for extraction in accordance with ASTM D 2172 and sieve analysis in accordance with AASHTO T 30. Test samples for stability and flow in accordance with ASTM D 1559. When two consecutive tests fail to meet requirements of specifications, cease placement operations and test a new trial batch prior to resumption of placement operations. Submit 2 per day of each mix type. When two tests on uncompacted mix fail submit new trial batch for approval.

3.3.2.2 Testing of Pavement Course

- a. Density: Determine density of pavement by testing cores obtained from the binder and wearing course in accordance with AASHTO T 230. Take three cores at location designated by Contracting Officer for each 200 tons, or fraction thereof, of asphalt placed. Deliver cores undisturbed and undamaged to laboratory and provide test results within 48 hours of each day placement of paving materials.
- b. Thickness: Determine thickness of the binder and wearing course from cores taken for density test.
- c. Straightedge Test: Test compacted surface of binder course and wearing course with a straightedge as work progresses. Apply straightedge parallel with and at right angles to center line after final rolling. Variations in the binder course surface shall not be more than 1/4 inches from the lower edge of the 10 foot straightedge; variations in wearing course surface shall not be more than 1/4 from the lower edge of the 10 foot straightedge. Pavement showing irregularities greater than that specified shall be corrected as directed by Contracting Officer.

3.3.2.3 Alternate Testing Method for Pavement Courses

At Contractor's option the following in-place testing method may be used to determine density and thickness in lieu of testing specified above. Frequency of testing shall be the same. When in-place nuclear method to determine density is used, take two pavement cores at locations designated by Contracting Officer and turn over to TPWD to verify pavement thickness.

- a. Density: Determine density of pavement by in-place testing using Nuclear Method in accordance with ASTM D 2950.
- b. Thickness: Determine thickness of finished pavement by use of following equation:

$$t = \frac{W}{0.75d}$$

Where t= pavement thickness, in inches. W= average weight per square yard of mixture actually used in work.

d= compacted density as measured by nuclear density device.

3.4 WASTE MANAGEMENT

Protect excess material from contamination and return to manufacturer, or reuse on-site for walkways, patching, ditch beds, speed bumps, or curbs.

END OF SECTION 32 12 13

SECTION 32 15 40
DECOMPOSED GRANITE WALKWAYS

PART 1 – GENERAL

1.1 SUMMARY

This standard specification item shall govern furnishing and placing granite gravel surfacing for walkways. The granite gravel surface shall be constructed in a single layer on an approved and properly prepared base course, conforming to typical sections and to the lines and grades indicated on the drawings or established by the engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses.

1.2 UNIT PRICE

Payment for decomposed granite walkways shall be full compensation for subgrade preparation, furnishing and installing decomposed granite, furnishing and installing binder, proof rolling, tools, labor and any incidentals to complete the work.

Unit of measure: Per the schedule of values.

1.3 SUBMITTALS

The submittal requirements of this specification item may include:

- A. Sample of decomposed granite gravel surface material along with source identification and gradation and plasticity test results for approval, quality assurance and color;
- B. Sample of flexible road base material or approved equivalent along with source identification and gradation and plasticity test results for approval, quality assurance and color;
- C. Optimum moisture-density characteristics for decomposed granite gravel and road base sources;
- D. Proposed walkway construction sequence and equipment; and
- E. Field density test results for in-place compacted red granite gravel and red road base.

PART 2 - PRODUCTS

2.1 DECOMPOSED GRANITE

The surface and base layer materials shall be approved by the Engineer or designated representative prior to being hauled to the Project.

The decomposed granite gravel and road base materials or approved equivalent shall be meet or exceed to the following TxDoT standard test methods:

a) Preparation for Soil Constants and Sieve Analysis	Tex-101-E
b) Moisture Content	Tex-103-E
c) Liquid Limit	Tex-104-E

d) Plastic Limit	Tex-105-E
e) Plasticity Index	Tex-106-E
f) Sieve Analysis	Tex-110-E
g) Laboratory Compaction	Tex-113-E
h) Field Density	Tex-115-E

The surface layer material shall be from a source approved by the Engineer or designated representative and shall be composed of a mixture of Texas decomposed unwashed granite aggregate and clay fines that meets the following requirements:

Sieve Designation		% Passing
US	SI	
1/4"	19 mm	100
#40	425 µm	40 to 45
# 200	75 µm	15 to 25
Plasticity Index		12 to 18

PART 3 - EXECUTION

3.1 GENERAL

Prior to commencement of this work, all required erosion controls and tree protection measures indicated on the Drawings shall be in place. All existing utilities shall be located and protected as specified in the Standard Contract Documents.

Areas within the construction limits shall be cleared of all obstructions, abandoned structures, and other items as defined above. All vegetation, except trees or shrubs indicated for preservation, shall also be removed. Trees and shrubs, which are scheduled for preservation, shall be carefully trimmed as directed by the engineer or designated representative and shall be protected from scarring, barking or other injuries during construction operations. All exposed cuts over 2 inches (50 millimeters) in diameter, exposed ends of pruned limbs or scarred bark shall be treated with an approved asphalt material within 24 hours of the pruning or injury.

Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the Contract Documents. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

3.2 SUBGRADE PREPARATION

The subgrade shall be excavated and shaped in conformity with the typical sections shown on the drawings and to the lines and grades as established by the Engineer or designated representative. The subgrade shall be tested by "proof rolling", except that a 10-ton roller will be used prior to placement of the road base material. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials.

If required the subgrade shall be wetted, reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the red road base material. The surface of the subgrade shall

be finished true to line and grade as established by the Engineer or designated representative in conformity with the typical section shown on the drawings. Material excavated in the preparation of the subgrade shall be utilized in the construction of adjacent shoulders and slopes or otherwise disposed of as directed by the Engineer or designated representative. Additional material required for completion of the shoulders and slopes shall be secured from sources approved by the owner.

3.3 FLEXIBLE BASE (N/A)

3.4 DECOMPOSED CRUSHED GRANITE SURFACE INSTALLATION

Decomposed crushed granite to be installed with StaLok Paving Material. Refer specification 32 15 43.

END SECTION 32 15 40



Stabilizer Solutions, Inc.
33 S. 28th St.
Phoenix, AZ 85034
800-336-2468 (Fax) 602-225-5902
Website: stabilizersolutions.com
E-Mail: info@stabilizersolutions.com

SECTION 32 15 43

**STALOK® PAVING MATERIAL WATERLESS NATURAL PAVEMENT FOR
PATHWAYS AND PATIOS**

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section consists of all paving work and related items as indicated on the drawings and or as specified herein and includes, but is not limited to, the following items:
 - 1. StaLok® Paving Material aggregate pathway or patio surfacing
- B. Related Sections:
 - 1. Section 02100 – Site Preparation
 - 2. Section 02200 – Earthwork
 - 3. Section 02230 – Granular Materials
- C. General Provisions
 - 1. All of the contract documents, including General and Supplementary Conditions and Division I General Requirements, apply to the work of this Section.
 - 2. Examine all drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.
 - 3. Coordinate work with that of all those affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

1.2 PERFORMANCE REQUIREMENTS

- A. The following standards and definitions are applicable to the work of this Section to the extent referenced herein:
 - 1. Standard Specifications: Highway Department, Standard Specifications for Highways and Bridges, latest edition.
 - 2. ASTM: American Society for Testing and Materials.
 - 3. AASHTO: American Association of State Highway and Transportation Officials.

1.3 SAMPLES AND SUBMITTALS

- A. Sieve analysis of aggregate for pathways and patios.
- B. Samples and or shop drawings for the following:

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STALOK PAVING MATERIAL WATERLESS
NATURAL PAVEMENT FOR PATHWAYS
AND PATIOS

1. Aggregate for strength and color.
- C. LEED Submittals
 1. Credit MR 5 – Regional Materials: Attach product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
- D. Construction Samples:
 1. Construct mock-up panels or areas for each different type of paving system as specified herein to demonstrate ability to archive types of setting bed, joints, pattern, color and texture required herein.
 2. StaLok® Paving Material for aggregate pathway and patio surfacing: Construct a 12' x 24' sample of finished path as directed by the Owner's Representative on site.
 3. General:
 - a. Schedule mock-up construction so that mock-up can be accepted a minimum of 30 days prior to the application of paving surfaces represented by the mock-up.
 - b. Locate mock-up panel(s) in areas as directed by the Owner's Representative.
 - c. Continue to construct mock-ups until acceptable mock-up is produced (at no cost to the Owner). Acceptable mock-up shall be standard for texture, color and workmanship.
 - d. Use same setting bed and joint mixes used in accepted mock-up in final work unless otherwise directed by Owner's Representative.
 - e. Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-ups.
 - f. Remove mock-up panel(s) from the site at completion of the project, unless otherwise instructed by Owner's Representative.

1.4 PROJECT/SITE CONDITIONS

- A. Field Measurements: Each bidder is encouraged to visit the site of the work to verify the existing conditions. No adjustments will be made to the Contract Sum for variations in the existing conditions.
 1. Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.
 2. Before proceeding with work, notify the owner's representative in writing of unsuitable conditions and conflicts.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer to provide evidence to indicate successful experience in installation of StaLok® Paving Material or approval by manufacturer.
- B. Manufacturer's technical representative shall visit the site at the start of an installation to ensure the installer understands the correct installation methods to use.

1.6 WARRANTY

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STALOK PAVING MATERIAL WATERLESS
NATURAL PAVEMENT FOR PATHWAYS
AND PATIOS

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the installer agreeing to repair or replace components of StaLok® Paving Material that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 - 1. Premature wear and tear, provided the material is maintained in accordance with manufacturer's written maintenance instructions.
 - 2. Failure of system to meet performance requirements.
- C. Warranty Period: Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.
- D. Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. StaLok® Paving Material Waterless Natural Pavement is provided by the following manufacturer:
 - 1. Stabilizer Solutions, Inc. 33 South 28th St., Phoenix, AZ 85034; phone (602) 225-5900, (800) 336-2468; fax (602) 225-5902; website www.stabilizersolutions.com; email info@stabilizersolutions.com

2.2 MATERIALS

- B. Aggregate Specifications
 - 1. Crushed stone shall consist of inert materials that are hard, durable, with stone free from surface coatings and deleterious materials. Gradation requirements shall be as follows:

U.S. Sieve No.	Percent Passing by Weight
# ½-inch	98 – 100
# 3/8-inch	90 – 100
# 4	65 – 80
# 8	48 – 63
# 16	40 – 49
# 30	30 – 40
# 50	20 – 27
# 100	10 – 18
# 200	10 – 12

- 2. R-value minimum of 70 determined by ASTM D 2488 Methodology (R-value is a measure of wear resistance).
 - 3. Sand equivalent – an engineering measurement of the proportion of sand to silt and clay, will stay at a range of 30-55. As determined by ASTM D 2419 methodology.

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4. Dense graded crushed stone base shall be furnished and installed as required and specified under Section 02200, Earthwork and Section 02230 Granular Materials to a 6" compacted depth.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Base shall be 3" thick layer of your state's DOT crushed granular base material installed at 95% compaction on top of subgrade by Test Method ASTM D 1557. Compaction testing to be provided by project owner no less than one test per 2,000 square feet of pavement base layer.
- B. Make any corrections necessary to base furnished and installed under Section 02200 Earthwork and Section 02230 Granular Materials to bring gravel to the sections and elevations shown on the drawings.
- C. Pre-soak base material with water prior to installing StaLok® Paving Material as needed to compact base.
- D. Make sure proper drainage is available to ensure no standing water on surface or adjacent to StaLok® Paving Material, including downspouts when placed under roof overhang.

3.2 BLENDING

- A. Waterless Natural Pavement (WNP) blending shall be under the direction of a WNP manufacturer with not less than 10 years experience in the production of WNP product. WNP shall be prepared with mixing plant dedicated to WNP production and equipped with metering controls for accurate proportioning of WNP ingredients. Aggregate must be heated to 200 degrees Fahrenheit by use of drum dryer prior to blending.
- B. The mixed WNP shall have a dry static coefficient of friction greater than .60. Water shall bead or form droplets on WNP surface and shed off. WNP shall set up only by compaction and can be stockpiled up to 1 month prior installation.

3.3 PLACEMENT/COMPACTION

- A. Consult manufacturer if installing on slope.
- B. Do not install in rainy conditions.
- C. Avoid installing WNP Material below 30°F. WNP Material may form clods during transport below 60°F. Large clods may be broken apart with machinery such as front loader, or on their own if left to warm in sun. Small clods will break apart during placement and compaction.
- D. Place WNP at a minimum 2", maximum 3" compacted depth. Using a Paver Box, Paver, Crawler Paver, Asphalt Paver, Drag Box Paver, Pavement Profiler, Slip Form Paver, Pav-Saver Place Spreader, Front Loader or Equal.
 1. Crown WNP. Slope material to edge ¼" per foot.
 2. Pockets of large aggregate may develop, inspect surface and evenly spread any 1/4" or 3/8" loose rock.
- E. Compact WNP.

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1. Compaction can be achieved by a 1 to 5-ton double-drum roller
2. Lightly compact making one pass.
3. Make any grade adjustments and add needed material.
4. Heavily compact material making 8 to 10 passes. Avoid turning on material with roller.
5. Use plate compactor on edges and hard to get areas. If near wall, hand tamp may be necessary.
6. Loose material shall not be present on final surface.
7. No set up or curing time is needed.

3.4 INSPECTION

- A. Finished surface shall be uniform and solid, with no evidence of chipping or cracking. Compacted paving material shall be firm to full depth with no soft areas. Loose material shall not be present on the surface and no ruts shall be present. Compaction may increase with time and use. WNP shall be ready for traffic immediately and shall not require fog seal or any other sealing or curing methods.

3.5 MAINTENANCE

- A. Remove debris, such as paper, grass clippings, leaves or other organic material by mechanically blowing or hand raking the surface as needed. Any plowing program required during winter months shall involve the use of a rubber baffle on the plow blade or wheels on the plow that lifts the blade 1/4" off the paving surface.

3.6 REPAIRS

- A. Excavate damaged area to the depth of the WNP and square-off sidewalks.
- B. If area is dry, moisten damaged portion lightly and scarify.
- C. Apply pre-blended WNP to excavated area to finish grade.
- D. Compact with an 8" to 10" hand tamp or 1000 lb. Roller.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.1 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 RELATED DOCUMENTS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 602	(2007) Agricultural Liming Materials
ASTM D 4427	(2007) Peat Samples by Laboratory Testing
ASTM D 4972	(2001; R 2007) pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.3 DEFINITIONS

1.3.1 Stand of Turf

95 percent ground cover of the established species.

1.4 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.5 SUBMITTALS

Submittals will be handled in accordance with the TPWD UGC.

Submittals shall include:

Wood cellulose fiber mulch

Fertilizer

Include physical characteristics, and recommendations.

Topsoil composition tests (reports and recommendations).

State certification and approval for seed

Erosion Control Materials

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

1.6.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.6.1.2 Fertilizer Gypsum Sulfur Iron and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer gypsum sulphur iron and lime may be furnished in bulk with certificate indicating the above information.

1.6.2 Storage

1.6.2.1 Seed Storage

Store in cool, dry locations away from contaminants.

1.6.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.6.2.3 Handling

Do not drop or dump materials from vehicles.

1.7 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.7.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.8 TIME LIMITATIONS

1.8.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 - PRODUCTS

2.1 SEED

Seeding mixes shown on the plans shall be provided. Native American Seed or approved equal seed supplier.

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

2.1.2 Seed Mixture by Weight

Areas disturbed by construction shall be seed with seed mix and application rate as shown on plan.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

On site topsoil material shall be used. If additional topsoil is needed, clean, weed free topsoil shall be provided.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil as needed shall be furnished by the Contractor.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D 4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	25-50 percent
Clay	10-30 percent
Sand	20-35 percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate or burnt limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 110 percent for hydrate or 140 percent for burnt limestone.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 61 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following ratios, by weight, of plant food nutrients:

- 1 parts nitrogen
- 0 part phosphorus
- 0 parts potassium
- traces of iron

In addition fertilizer shall contain 50 percent slow-release nitrogen.

2.4.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the minimum ratios, by weight, of plant food nutrients as listed above in Section 2.4.1.

- 18 percent available nitrogen
- 18 percent available phosphorus
- 18 percent available potassium

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

2.5.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent) or wood-based (100 percent) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water shall be approved by TPWD ODR and of suitable quality for irrigation, containing no elements toxic to plant life.

2.7 EROSION CONTROL MATERIALS

Erosion control material shall conform to the following:

2.7.1 Erosion Control Blanket

70 percent agricultural straw/30 percent coconut fiber matrix stitched with degradable nettings designed to degrade within 18 months.

2.7.2 Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.3 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of off-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters and/or soil conditioners into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the TPWD ODR. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Finished topsoil areas must be protected from damage by vehicular or pedestrian traffic. No on site topsoil shall be used.

3.1.1.2 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Organic Granular Fertilizer 10 pounds per 1000 square feet.

Hydroseeding Fertilizer 10 pounds per 1000 square feet.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the TPWD's ODR stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half of the seed in one direction, and sow remainder at right angles to the first sowing direction.

3.2.2 Seed Application Method

Seeding method shall be hydroseeding.

3.2.2.1 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. Fiber shall be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed shall be mixed to ensure broadcasting at the rates listed in Section 2.1.2. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.2.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.3.4 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.4 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the TPWD ODR.

3.2.5 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF SEEDED/GRASSED

Immediately after seeding and/or grass establishment, the seeding area against traffic and other use must be protected.

3.4 Policing

The Contractor shall police all landscaped areas. Policing includes removal of leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks or other debris. Policing shall extend to both sides of fencing or walls. Collected debris shall be promptly removed and disposed of at an approved disposal site.

3.5 IRRIGATION ESTABLISHMENT PERIOD

The irrigation establishment period will commence on the date that inspection by the Contracting Officer shows that the temporary irrigation equipment furnished under this contract have been satisfactorily installed and is functional and shall continue for a period of 365 days.

3.5.1 Maintenance During the Irrigation Establishment Period

Begin maintenance immediately after irrigation equipment has been installed and is functional. Inspect irrigation equipment at least once a week during the installation and establishment period and perform needed maintenance promptly. Automatic controllers not equipped with rain shut-off sensors shall be turned off during periods of rain that exceed twelve hours of continuous rainfall in one day or during rain storms of one day or more. Once the rain has subsided timers shall be reactivated. Irrigation controllers shall be inspected and reprogrammed after power outages. Contractor shall be responsible for winterization and startup. Sprinkler heads shall direct water away from buildings and hard surfaced areas.

3.5.2 Water Restrictions

The Contractor shall abide by state, local or other water conservation regulations in force during the establishment period. Automatic controller shall be adjusted to comply with the water conservation regulations schedule.

3.5.3 Final Acceptance

Upon completion of the irrigation establishment period and final acceptance of groundcover and exterior plants, irrigation equipment shall be removed.

3.6 GROUNDCOVER ESTABLISHMENT PERIOD

Groundcover establishment period will commence on the date that inspection by the TPWD ODR shows that the new turf furnished under this contract has been satisfactorily installed to a 95 percent stand of coverage. **The establishment period shall continue for a period of 730 days.**

3.6.1 Frequency of Maintenance

Begin maintenance immediately after turf has been installed. Inspect areas once a week during the installation and establishment period and perform needed maintenance promptly.

3.6.2 Promotion of Growth

Groundcover shall be maintained in a manner that promotes proper health, growth, natural color. Turf shall have a neat uniform manicured appearance, free of bare areas, ruts, holes, weeds, pests, dead vegetation, debris, and unwanted vegetation that present an unsightly appearance. Mow, remove excess clippings, eradicate weeds, water, fertilize, overseed, and perform other operations necessary to promote growth, as approved by TPWD ODR and consistent with approved Integrated Pest Management Plan. Remove noxious weeds common to the area from planting areas by mechanical means.

3.7 RESTORATION

Restore to original condition existing turf /grassed areas which have been damaged during seeding operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

3.8 Payment

Payment for Seeding shall be by the unit established in the schedule of values and will be full compensation for furnishing, installing, watering and maintenance as specified in this section.

Payment for Topsoil shall be by the unit established in the schedule of values and will be full compensation for preparing, stockpiles, re-installation of topsoil as shown in the plans and where restoration is required.

END OF SECTION 32 92 19

SECTION 33 46 16

SUBDRAINAGE PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICES

- A. Pipe Subdrains

Measure the length of pipe installed from end to end along the centerlines without any deduction for the diameter of the manholes. Pipe will be paid for according to the number of linear feet of subdrains placed in the accepted work. Payment for bedding and drainage layer, filter materials, geotextiles, backflow prevention and rodent guard will be included in the payment for the pipe subdrain system.

Unit of Measure: Per Schedule of Values.

- B. Manholes

Manholes to be paid for will be the number of manholes completed with base, rungs or ladders, frames, and covers or gratings (where specified) constructed in the accepted work.

Unit of Measure: Per Schedule of Values.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 190	(2004; R 2017) Standard Specification for Asphalt-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 252	(2009; R 2017) Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M 288	(2017) Standard Specification for Geosynthetic Specification for Highway Applications

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A27/A27M	(2017) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47/A47M	(1999; R 2014) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2012) Standard Specification for Gray Iron Castings
ASTM A760/A760M	(2015) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A762/A762M	(2015) Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A798/A798M	(2017) Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM B745/B745M	(2015) Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C478M	(2018) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D2321	(2018) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2017) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3753	(2012; E 2013) Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM F758	(2014) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic

Underdrain Systems for Highway, Airport, and Similar Drainage

ASTM F949

(2015) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.4 SUBMITTALS

TPWD approval is required for submittals with a "TPWD" designation; submittals not having a "TPWD" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

1. Samples
 - a. Geotextile
 - b. Pipe and Pipe Fittings
2. Certificates
 - a. Geotextile
 - b. Pipe and Pipe Fittings

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage

Inspect materials delivered to site for damage; unload, and store with minimum handling. Do not store materials directly on the ground. Keep the inside of pipes and fittings free of dirt and debris. Keep, during shipment and storage, geotextile wrapped in burlap or similar heavy-duty protective covering. Protect the geotextile from mud, soil, dust, and debris. Do not store geotextile materials in direct sunlight. Install plastic pipe within 6 months from the date of manufacture unless otherwise approved.

B. Handling

Handle materials in such a manner as to ensure delivery to the trench in sound undamaged condition. Carry pipe to the trench.

PART 2 – PRODUCTS

2.1 PIPE FOR SUBDRAINS

Submit samples of pipe and pipe fittings, before starting the work. Provide type and sizes of subdrain pipe indicated. Submit certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe and fittings.

A. Plastic

Provide plastic pipe containing ultraviolet inhibitor to provide protection from exposure to direct sunlight. Provide pipe with bell and spigot or solvent cement joints. Provide manufacturer's standard type fittings conforming to the indicated specification.

B. Polyvinyl Chloride (PVC) and Fittings

1. Pipe—The pipe shall be as uniform as commercially practicable in color, opaqueness, density, and other specified physical properties. It shall be free from visible cracks, holes, foreign

inclusions, or other defects. The dimensions of the pipe shall be measured as prescribed in ASTM D 2122.

2. Fittings and joints—Fittings and joints shall be of a schedule, SDR or DR, pressure class, external load carrying capacity, or pipe stiffness that equals or exceeds that of the plastic pipe. The dimensions of fittings and joints shall be compatible with the pipe and measured in accordance with ASTM D 2122. Joint and fitting material shall be compatible with the pipe material. The joints and fittings shall be as uniform as commercially practicable in color, opaqueness, density, and other specified physical properties. It shall be free from visible cracks, holes, foreign inclusions, or other defects. Fittings and joints shall conform to the requirements listed in this specification, the requirements of the applicable specification referenced in the ASTM or AWWA specification for the pipe.
3. Solvents—Solvents for solvent welded pipe joints shall be compatible with the plastic pipe used and shall conform to the requirements of the applicable specification referenced in the ASTM or AWWA specification for the pipe, fitting, or joint.
4. Gaskets—Rubber gaskets for pipe joints shall conform to the requirements of ASTM F 477, Elastomeric Seals (Gaskets) for Jointing Plastic Pipe.

C. Pipe Perforations

1. Provide pipe perforations with a minimum water inlet area of 0.5 square inch per linear foot and as specified below.
2. Circular Perforations in Plastic Pipe
 - a. Cleanly cut circular holes not more than 3/8 inch or less than 3/16 inch in diameter and arrange in rows parallel to the longitudinal axis of the pipe. Provide pipe with perforations spaced uniformly along rows. Unless otherwise recommended by the pipe manufacturer, provide pipe with rows approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. Space the rows over not more than 155 degrees of circumference. Provide pipe that is not perforated for a length equal to the depth of the socket at the spigot or tongue end and provide perforations that continue at uniform spacing over the entire length of the pipe.
3. Slotted Perforations in Plastic Pipe
 - a. Cleanly cut circumferential slots so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the pipe. Provide pipe with slots not exceeding 1/8 inch nor less than 1/32 inch in width. Provide pipe with individual slot lengths not exceeding 10 percent of the pipe inside nominal circumference on 6 to 8-inch diameter pipe, and 2-1/2 inches on 10 inch diameter pipe. Symmetrically space rows of slots so that they are fully contained in 2 quadrants of the pipe. Center slots in the valleys of the corrugations of profile wall pipe.

2.2 GEOTEXTILE

- A. Provide geotextile meeting the requirements in Section 31 05 19 GEOTEXTILE.
- B. Submit samples of geotextile and certifications from the manufacturers attesting that geotextile meets specification requirements.

2.3 DRAINAGE LAYER, SUBDRAIN FILTER AND BEDDING MATERIAL

Provide subdrain filter and bedding material composed of washed sand, sand and gravel, crushed stone, crushed stone screenings, or slag composed of hard, tough, durable particles free from adherent coatings. Filter material may not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles. Provide filter material that is evenly graded between the limits specified in TABLE I. Gradation curves will exhibit no abrupt changes in slope denoting skip or gap grading. Provide filter materials that are clean and free from soil and foreign materials. Remove and replace filter blankets found to be dirty or otherwise contaminated with material meeting the specific requirements, at no additional cost to TPWD.

TABLE I		
	TYPE I GRADATION E 11 ASTM C33	TYPE II GRADATION 57 ASTM C33
ASTM C 136 SIEVE SIZE	PERCENT PASSING	PERCENT PASSING
1-1/2 INCH	--	100
1 INCH	--	90 - 100
3/8 INCH	100	25 - 60
NO. 4	95 - 100	5 - 40
NO. 8	--	0 - 20
NO. 16	45 - 80	--
NO. 50	10 - 30	--
NO. 100	0 - 10	--

2.4 DRAINAGE STRUCTURES

A. Concrete

Provide concrete and reinforced concrete conforming to the requirements in Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE.

B. Mortar

Provide mortar for connections to drainage structures that is composed of one part by volume of portland cement and two parts of sand. Provide sufficient quantity of water in the mixture to produce a stiff workable mortar. Use water that is clean and free of injurious acids, alkalies, and organic impurities. Use the mortar within 30 minutes from the time the ingredients are mixed with water.

C. Manholes and Appurtenances

1. Frames and Covers or Gratings

- a. Except as otherwise permitted, provide frames and gratings, or frames and covers of either cast iron with tensile strength test not less than ASTM A48/A48M Class 25 or steel conforming to ASTM A27/A27M, Class 65-35. Required weight, shape, and size are indicated on the drawings. Frames and covers not subjected to vehicular traffic or storage may be of malleable iron where indicated. Provide malleable-iron frames and covers conforming to ASTM A47/A47M and of the weight, shape, and size indicated.
2. Ladder
 - a. Provide a FRP ladder where the depth of a manhole exceeds 12 feet in accordance with 06 71 33 Fiberglass Reinforced Plastic (FRP) Ladders. Galvanize ladders and inserts after fabrication in conformance with ASTM A123/A123M.

PART 3 – EXECUTION

3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Excavate trenches, including the removal of rock and unstable material, in accordance with Section 31 23 00 Earthwork. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified for cohesionless material in Section 31 20 00 EARTHWORK.

3.2 MANHOLES AND FLUSHING AND OBSERVATION RISERS

A. Manholes

Install manholes complete with frames and covers or gratings at the locations and within the limits and sizes indicated. Construct manholes of one of the materials specified for manholes in paragraph DRAINAGE STRUCTURES.

B. Flushing and Observation Risers

Install flushing and observation riser pipes with frames and covers at the locations indicated. Construct risers of non-perforated plastic pipe. Join riser pipes to the subdrain system as indicated.

3.3 INSTALLATION OF GEOTEXTILE AND PIPE FOR SUBDRAINS

A. Installation of Geotextile

1. Trench Lining and Overlaps

- a. Grade trenches to be lined with geotextile to obtain smooth side and bottom surfaces so that the geotextile will not bridge cavities in the soil or be damaged by projecting rock. Lay the geotextile flat but not stretched on the soil and secure it with anchor pins in accordance with manufacturer's instructions. Overlap at least 6 to 12 inches, and secure with anchor pins along the overlaps.

B. Installation of Pipe for Subdrains

1. Outlets subject to flooding will be provided with suitable and properly installed check valves or flap gates.
2. Pipelaying
 - a. Install pipe in accordance with the manufacturer's recommendations. Thoroughly examine

each section of pipe before being laid; do not use defective or damaged pipe. Do not lay pipe when the trench conditions or weather is unsuitable for such work. Remove water from trenches by sump pumping or other approved methods. Lay the pipe to the grades and alignment as indicated. Bed the pipe to the established gradeline. Center perforations on the bottom of the pipe. Lay bell-and-spigot type with the bell ends upstream. Approval of all in-place pipes by the Contracting Officer is required prior to backfilling.

3.4 INSTALLATION OF DRAINAGE LAYER, MATERIAL AND BACKFILLING FOR PERFORATED SUBDRAINS

After perforated pipe for subdrains has been laid, inspected, and approved, place drainage layer material around and over the pipe to the depth indicated. Place the drainage layer material in layers not to exceed 8 inches thick. Thoroughly compact each layer using mechanical tampers or rammers.

3.5 INSTALLATION OF BEDDING AND BACKFILL FOR NON-PERFORATED SUBRAIN OUTFALL PIPE

A. Plastic Pipe

Place and compact pipe embedment for plastic pipe in accordance with ASTM D2321. Use Class IB or II embedment materials.

3.6 INSTALLATION OF AND BACKFILLING FOR BLIND OR FRENCH DRAINS

Place filter material as indicated and compact as specified for cohesionless materials in Section 31 23 00.00 20 EXCAVATION AND FILL. Extend filter material to a suitable outlet or to an outlet through a pipeline as indicated. Place and compact overlying backfill material as specified in Section 31 23 00.00 20 EXCAVATION AND FILL.

END OF SECTION 33 46 16

SECTION 35 73 13

EMBANKMENT FOR EARTH AND ROCKFILL DAMS

PART 1 – GENERAL

This specification provides for furnishing all materials, labor, and equipment, and performing all operations in connection with the placement of embankment materials for construction of the earthen dam.

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

All the standard project management coordination, scheduling and reporting requirements are already provided for in the Texas Parks and Wildlife Department's Uniform General Conditions 2015 (UGC). The contractual provisions and methods established within the UGC document will govern this project if there is any discrepancy or confusion with contractual language contained in these technical specifications.

1.2 UNIT PRICES

A. Compacted Fill

- 1. Payment: Payment will be made for costs associated with placement of compacted fill embankment; spreading, harrowing, moisture control, compacting, removing objectionable materials; and all other incidental work required for the construction, protection, and maintenance of the dam embankment. This payment is separate to any payment for excavating and transporting of material as specified in Section 31 10 00 EARTHWORK.
- 2. Measurement of Fill Material: Compacted fill will be measured for payment in place based upon the established limit lines and the payment lines shown on the plans or as otherwise established. Limit lines will be established by the volume between the foundation lines as determined on the basis of a survey made from excavation and accomplishment of foundation preparation (except scarifying) and the lines, grades and slopes of the accepted embankment.
- 3. Unit of Measure: Per Schedule of Values.

B. Filter Sand

- 1. Payment: Payment will be made for costs associated with obtaining filter sand, transportation to the site (whether from required excavation, borrow, or commercial source), mixing the materials to the required gradation, spreading, moisture control, compacting, removing objectionable materials, and all other incidental work required for the construction, protection, and maintenance of the filter. This payment is in addition to any payment for excavation (from required excavation or borrow) of the material as specified in Section 31 10 00 EARTHWORK.
- 2. Measurement: Filter sand will be measured for payment in place based upon the established limit lines and the payment lines indicated on the cross sections shown on the plans or as otherwise established. Limit lines will be established by the volume between the foundation lines as

determined on the basis of a survey made from excavation and [accomplishment of foundation preparation (except scarifying)] and the lines, grades and slopes of the accepted embankment.

3. Unit of Measure: Per Schedule of Values.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM D1140	(2017) Standard Test Methods for Determining the Amount of Material Finer than 75-μm (No. 200) Sieve in Soils by Washing
ASTM D1556/D1556M	(2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2216	(2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2487	(2017) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2937	(2017; E 2017; E 2018) Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D422	(1963; R 2007; E 2014; E 2014) Particle-Size Analysis of Soils
ASTM D4253	(2016) Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	(2016) Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4643	(2017) Standard Test Method for Determination of Water Content of Soil and Rock by Microwave Oven Heating

ASTM D5195	(2014) Density of Soil and Rock In-Place at Depths Below the Surface by Nuclear Methods
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

1.4 DEFINITIONS

- A. Embankment: Embankment, as used in these specifications, is defined as the earth fill portions of the dam structure and includes all types of earth fill and filter materials for the dam and all other specified or directed earth and rock fills within the limits of the dam.
- B. Compacted Fill: Compacted fill includes all fill deposited in layers and compacted by rolling or tamping. The types of compacted earth fill are:
 - 1. Structural fill forming the upstream and downstream sections of the embankment or where indicated on the plans, and
 - 2. Filter drainage layers forming the horizontal and vertical pervious drainage blankets.
- C. Backfill: Backfill, as used in these specifications, is defined as that excavation refill which cannot be placed around or adjacent to a structure until the structure is completed and reached a specified concrete strength, requires special compaction efforts, and is defined by limits indicated on the plans and specifications.
- D. Filter Materials: Filter materials are defined as material used as drainage or transition zones between various types of fill and backfill (impervious, pervious, random, and rock fill).
- E. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Materials unsatisfactory for use as fill and backfill are those earth and earth mixtures that classify by ASTM D2487 as OL, OH, and PT. In addition, all topsoil, organics, roots and other organic matter, biodegradable materials, debris, trash, rubble and contaminated soil is unsatisfactory for use as embankment, backfill or engineered fills. Unsatisfactory materials or processes are not in compliance with these specifications. Notify the Contracting Officer when encountering any contaminated materials.
- F. Unsatisfactory vs Satisfactory: The use of the terms satisfactory and unsatisfactory in this section is in reference to the Contract requirements. Satisfactory materials or processes are in full compliance with these specifications and unsatisfactory materials or processes are not in compliance with these specifications.

1.5 SYSTEM DESCRIPTION

- A. Haul Roads
 - 1. Haul roads must be located and constructed as approved. Design haul roads to maintain the intended traffic, to be free draining and maintain good condition throughout the contract period, unless otherwise directed. Remove haul roads within the area of contact between the embankment and its foundation and abutments and treat the area as specified in paragraph

PREPARATION OF FOUNDATION, PARTIAL FILL SURFACE, AND ABUTMENTS.

2. Submit a Plan of Operations for approval thirty days prior to commencement of haul road construction or placing embankment and backfill, whichever is earlier, for accomplishing all embankment and backfill construction and for the location and construction of haul roads.

B. Stockpiling from Approved Borrow Sources or Required Excavations

1. When the excavation from approved borrow sources or required excavations progresses at a faster rate than placement in the fill is being accomplished, stockpile excavated material at approved locations adjacent to the work until its use is authorized. No payment will be made for such stockpiling nor for the reloading and hauling of this material to its final position in the embankment.

1.6 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

A. Preconstruction Submittals

1. Plan of Operations

- a. 30 days prior to commencement of haul road construction or placing embankment and backfill, whichever is earlier, submit for approval a Plan of Operations for accomplishing all embankment and backfill construction and for the location and construction of haul roads. This plan must include, but not be limited to, the proposed sequence of construction for embankment and backfill items, and methods and types of equipment to be utilized for all embankment and backfill operations, including transporting, placing, and compaction. Also include the names and addresses of the commercial testing labs which will perform the soil testing and inspection and describe how all required soils testing will be performed in this plan.

2. Embankment and Backfill Materials

- a. At least 30 days prior to delivery of any Contractor-furnished material to the site of the work, submit soil classification test results, moisture-density curves, gradation curves, and laboratory results of the required tests of the proposed material.

B. Test Reports

1. Foundation Inspection

- a. Provide a foundation inspection report, certified by a registered Professional Geotechnical Engineer or Geologist, documenting the inspection. The report must include, at a minimum, a description of each geologic stratum encountered along the slopes and excavation bottom, laboratory testing results if any tests were performed, and other pertinent information. The report's main body must be a color copy submitted to the TPWD within four calendar days of completion of the inspection by the Contractor's geologist. Include figures, tables and photographs as necessary.

2. Measurement of Fill Material

- a. Submit a copy of the records of each compliance survey the next work day following the survey.

3. Testing

- a. Within 24 hours of conclusion of physical tests, three copies of test results, including calibration curves and results of calibration tests.

C. Certificates Testing

Qualifications of the commercial testing laboratory or the Contractor's validated testing facilities.

1. Nuclear Density

Use nuclear density testing equipment in accordance with ASTM D6938. In addition, the following conditions are applicable:

- a. Prior to using the nuclear density testing equipment on the site, submit to the Contracting Officer a certification that the operator has completed a training course approved by the nuclear density testing equipment manufacturer, the most recent data sheet from the manufacturer's calibration, and a copy of the most recent statistical check of the standard count precision.
- b. Provide nuclear density testing equipment capable of extending a probe a minimum of 12 inches down into a hole.
- c. Field density reports must include the laboratory density reports applicable to the field data presented.

PART 2 – PRODUCTS

2.1 MATERIALS

Classification of soils will be in accordance with ASTM D2487.

A. General

1. The origin of any fill material in no way determines where it may be used in the embankment. Obtain materials for embankment fills from required excavations, or from off-site commercial sources as required. The intention is to use the most suitable materials obtainable from these sources. Material to be wasted will be specifically designated at the time the material is excavated. Materials containing brush, roots, sod, organics or other perishable materials will not be considered suitable. The suitability of the materials are subject to approval and their disposition in the embankment will be as directed.

B. Embankment Fill

Provide material for compacted embankment fill consisting of soils classified as SC, CL or CH in accordance with ASTM D4318, ASTM C136/C136M and ASTM D1140 obtained from required excavation or off-site commercial sources. LL = 20 to 60, PL = 10 to 20, PI = 10 to 40, percent passing No 200 size 30 and greater, and a maximum particle size of 3 inches.

C. Impervious Fill

Provide material for compacted impervious fill consisting of soils classified as CL or CH cohesive materials in accordance with ASTM D4318, ASTM C136/C136M and ASTM D1140 obtained from required excavation or off-site commercial sources. LL = 20 to 60, PL = 10 to 20, PI = 10 to 40, Percent Passing No. 200 Sieve 50 and greater, and maximum particle size 3 inches.

D. Structural Fill

Provide material for compacted random fill obtained from natural deposits within borrow areas and from designated excavations consisting of any or all types of satisfactory material, granular or silty fill, which are suitable for use in the dam embankment as documented in the Geotechnical Report.

E. Backfill

Provide backfill consisting of material of a type and quality conforming to that specified for the contiguous embankment fill material, unless otherwise directed.

F. Aggregate Drainage Layers

1. Drainage materials must meet the quality requirements of ASTM C33/C33M concrete aggregate except as stated herein. Drainage materials must consist of sand, gravel, or crushed stone composed of tough, durable, angular particles; must be free from thin, flat and elongated pieces, and must contain no organic matter or soft, friable particles. The material must be washed with clean water such that the final product has no visible soil, soil slurry, or objectionable coatings.
2. Gradation of the material must be determined in accordance with ASTM D2487, ASTM D422, ASTM D1140, and ASTM D4318. All points on individual grading curves obtained from representative samples of filter material must lie between the boundary limits as defined by smooth curves drawn through the tabulated grading limits plotted on a mechanical analysis diagram. The individual grading curves within these limits must not exhibit abrupt changes in slope denoting skip grading, scalping of certain sizes or other irregularities which would be detrimental to the proper functioning of the filter; and will be well-graded between the limits specified on the plans.

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. Lines and Grades

1. Construct the embankment to the lines, grades and cross sections indicated, unless otherwise directed. The TPWD reserves the right to increase or decrease the foundation widths or the embankment slopes or make such other changes in the embankment sections as may be deemed necessary to produce a safe structure. Increases in height of section, made to compensate for shrinkage or consolidation of the embankment material or foundation during construction of the embankment, will not exceed five percent of the height above the foundation indicated without the approval of the Contracting Officer. The end slopes and side slopes of partial fill sections must not be steeper than those shown.

B. Conduct on the Work

1. Maintain and protect the embankment in a satisfactory condition at all times until final completion and acceptance of all work under the contract. At all times protect fills, filters, and drainage layers from erosion, runoff, and contamination from different soils or other materials. These materials must be uncontaminated for minimum dimensions shown on the plans. Minimize equipment travel on these zones to prevent segregation, contamination, and breakdown of materials.
2. If in the opinion of the Contracting Officer the hauling equipment causes horizontal shears or slickensides, rutting, quaking, heaving, cracking or excessive deformation of the embankment, limit the type, load or travel speed of the hauling equipment on the embankment. Replace any embankment material rendered unsuitable after being placed in the embankment and before

final acceptance of the work in a satisfactory manner and no additional payment will be made therefor. Excavate and remove from the embankment any material which the Contracting Officer considers objectionable, dispose of such material, and refill the excavated area as directed, all at no cost to the TPWD. Do not place unsatisfactory materials in the embankment. The Contractor may be required to remove, without additional payment, any embankment material placed outside of prescribed slope lines.

3.2 PREPARATION OF FOUNDATION, PARTIAL FILL SURFACES AND ABUTMENTS

A. Earth

1. After excavation or stripping of the embankment foundation to the extent indicated or otherwise required, break down the sides of stump holes, test pits, and other similar cavities or depressions where so directed to flatten out the slopes, and scarify the sides of the cut or hole to provide bond between the foundation material and the fill.
2. Unless otherwise directed, fill material dependent upon the type of material which is to be placed immediately above the foundation.
3. Place the fill in layers; moisten and compact in accordance with the applicable provisions of paragraphs PLACEMENT, MOISTURE CONTROL, and COMPACTION. Spread materials which cannot be compacted by roller equipment because of inadequate clearances in 4-inch layers and compact with power tampers to an extent equal to that of the contiguous embankment fill material. After filling of depressions and immediately prior to placement of compacted fill in any section of the embankment, loosen the foundation of such section thoroughly by scarifying, plowing, discing or harrowing to a minimum depth of 12 inches, and adjust the moisture content to the amount specified in paragraph MOISTURE CONTROL for the appropriate type of material, except in areas where this requirement is waived by the Contracting Officer.
4. After removal of roots or other debris turned up in the process of loosening, compact the entire surface of the embankment foundation area complete coverages of the compaction equipment as specified for the appropriate type of fill in accordance with paragraph COMPACTION. Compacted to a density of 98 percent in accordance with paragraph COMPACTION. Proof roll foundation areas in accordance with Section 31 10 00 EARTHWORK paragraph PROOF ROLLING.
5. Prior to placement of compacted fill on or against the surfaces of any partial fill section, remove all soft or loose material, all material containing cracks or gullies, and all material that does not conform with the specified zoning of the embankment. Loosen the remaining surface of the partial fill by scarifying, plowing, discing or harrowing to a minimum depth of 6 inches, and adjust the moisture content as specified in paragraph MOISTURE CONTROL for the appropriate type of material. Compact the surface of the partial fill section upon which fill is to be placed as specified in paragraph COMPACTION for the appropriate type of fill. No separate payment will be made for loosening and rolling the foundation area, the abutment area, or the surfaces of partial fill sections, but include the entire cost in the applicable contract price for fill.

B. Foundation Inspection

1. Foundation means any area of the excavation to receive concrete, backfill, or embankment, including the entire excavation bottom and side slopes.
2. Inspections to determine the adequacy of the foundations will be performed by the Contracting Officer in all foundation areas between completion of the surface preparation and placement of

Embankment Fill, Filter Material, Mud Mat, CLSM, or concrete. The Contractor will cooperate to the extent necessary to assist in the inspection. This will include having equipment and personnel available to assist excavating, compacting, proof rolling, cleaning, etc. The Contractor must coordinate his schedule for foundation preparation and final cleanup with the Contracting Officer to ensure that the cleanup and inspection proceed in an orderly manner.

3.3 PLACEMENT

A. General

1. Do not place fill on any part of the embankment foundation until such areas have been inspected and approved by the Contracting Officer.
2. The gradation and distribution of materials throughout the compacted earth fill section of the dam must be such that the embankment will be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material of the same classification. Dump successive loads of material at locations on the fill as directed or approved. Do not place fill upon a frozen surface, nor shall snow, ice, or frozen earth be incorporated in the embankment. Fill will not be placed on or against any dry surface, but against a surface that is moist or damp.

B. Frozen Material

1. Do not place embankment on frozen material, or on material which has been subjected to freeze-thaw action. This prohibition encompasses natural ground, all prepared subgrades, whether in an excavation or on an embankment, and all layers of previously placed and compacted earth fill upon which successive layers of embankment fill will be placed. Remove all material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, or winter shutdowns or earthwork operations, to a depth that is acceptable to the Contracting Officer and replace with new material. Alternatively, the material must be thawed, dried, reworked, and recompact to the specified criteria before additional material is placed. The Contracting Officer will determine when placement of fill must cease due to cold weather. Embankment material containing frozen clumps of soil, snow, or ice is not acceptable.

C. Rate of Placement

1. Unless otherwise directed, maintain the embankment at approximately the same level regardless of the number of types of materials being placed.
2. Material placement shall be limited to 6 feet vertically per construction day to allow the placed fill to dissipate excess pore water pressure.

D. Structural Fill

1. Place Structural fill in the sections of the embankment as shown on the plans.

E. Filter Drainage Layers

1. Place sand filters in the embankment in the manner described and to the lines and grades indicated. Tolerance of plus or minus 2 inches will be allowed.

F. Spreading

1. After dumping, spread the materials by bulldozers or other approved means in approximately horizontal layers over the entire fill areas. Unless otherwise directed, the thickness of these layers before compaction with tamping type rollers must not be more 6 inches for embankment materials, except backfill which must be spread in accordance with paragraph BACKFILL.
2. Spread pervious fill and filters in layers not more than 6 inches in thickness. As soon as practicable after commencement of construction of any section of the embankment, raise or crown the central portion thereof with grades not to exceed 25 percent so that the surface of the fill will drain freely and maintain throughout construction. Filter material placement should lead the placement of adjacent material to avoid contamination of the filter material. If the compacted surface of any layer of material, exclusive of filter material, is determined to be too smooth to bond properly with the succeeding layers, loosen it by harrowing, or by any other approved method, before the succeeding layer is placed. At all times during the dumping and spreading processes, maintain a force of men adequate to remove all roots and debris from all embankment materials and all stones of greater than 3 inches in maximum dimension from materials, except filters. Remove stone, roots, and debris from the embankment and dispose of in an approved manner.
3. Maintain the entire surface of any section of the embankment under construction in such condition that construction equipment can travel on any part of any one section. Remove ruts in the surface of any layer by scarifying before placing and compacting additional material.

3.4 MOISTURE CONTROL

Provide materials in each layer of the fill containing the amount of moisture, within the limits, specified below or as directed, necessary to obtain the specified compaction. Rework material that is not within the specified limits after compaction regardless of density.

A. Filter Drainage Layers

1. Moisture control of graded gravel filter and bedding layers will not be required, and sluicing will not be permitted. Moisture control of filters containing a predominate amount of sand particles will be as required to achieve the density specified in paragraph COMPACTION.

3.5 COMPACTION

A. Equipment

1. Compaction shall be accomplished by hand tamping or manually directed power tampers, plate vibrators, walk-behind, miniature, or self-propelled rollers. Unless otherwise specified heavy equipment including backhoe mounted power tampers or vibrating compactors and manually directed vibrating rollers shall not be operated within 3 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist is not permitted.
2. The passage of heavy equipment will not be allowed:
 - a. Over cast-in-place conduits within 14-days after placement of the concrete
 - b. Over cradled or bedded precast conduits within 7 days after placement of the bedding
 - c. Over any type of conduit until the backfill has been placed above the top surface of the

structure to a height equal to one-half the clear span width of the structure or pipe or 3 feet, whichever is greater.

3. Compacting of earth backfill adjacent to structures shall not be started until the concrete has attained the strength specified. The strength is determined by compression testing of test cylinders cast by the contractor's quality control personnel for this purpose and cured at the work site in the manner specified in ASTM C 31 for determining when a structure may be put into service.

B. Additional Rolling for Compaction

1. If, in the opinion of the Contracting Officer, the desired compaction of any portion of the embankment is not achieved by the minimum number of coverages specified, make additional complete coverages over the surface area of such designated portion until the desired compaction has been obtained.

3.6 BACKFILL

A. General

1. Do not place embankment fill, filter soil or backfill against a concrete structure until the top of the structure has been completely placed, and has reached 80 percent of its design strength. Bring fill up in lifts evenly on both sides of structure and headwall structures with no more than 2 feet difference in elevation on opposing sides of the structure.

B. Placement

1. Place backfill in 6-inch layers and thoroughly compact. Unless otherwise directed, the placing and compacting of all backfill material and the control of its moisture content must conform to the applicable provisions of paragraphs PLACEMENT, MOISTURE CONTROL, and COMPACTION. Keep fill in back of wing walls at approximately the same elevations as that of the backfill, gravel blankets, riprap on the opposite side of the wall until placement has reached the maximum elevation of the materials to be placed on the toe of the wall. Keep drainage openings through walls open at all times.

3.7 FIELD QUALITY CONTROL

Establish and maintain field quality control for embankment and backfill operations to assure compliance with contract requirements and maintain detailed records of field quality control for all operations including but not limited to the following:

A. Materials Testing

Perform sufficient testing to ensure that the fill is being constructed as specified. The testing program specified below will be considered the minimum acceptable frequency of testing. This does not relieve the Contractor from the responsibility of performing additional testing, if required to ensure compliance with these specifications. Soil Classification Tests Soil classification tests will be performed in accordance with ASTM D2487. One initial classification test will be required for each different classification of material to be utilized as embankment fill or backfill. As prescribed in ASTM D2487, grain size analyses in accordance with ASTM D422 and Atterberg limits in accordance with ASTM D4318 will be performed on each different classification. Submit additional tests for every 500 cubic yards of embankment or backfill material. Soil classification tests will be performed on foundation material as required to determine the acceptability of the in-situ soils. Additional tests will be required if noticeable changes in the material occur.

1. Cohesive Material Testing

2. Moisture Density Relationships

- a. The moisture-density relations for each different classification of cohesive material utilized will be determined in accordance with ASTM D698. During fill placement a minimum of one additional moisture-density test will be performed for every 500 cubic yard placed. Additional tests will be required each time a new material is encountered. The moisture-density curves will be compiled to form a family of curves which will be utilized to estimate optimum properties (maximum dry density and optimum moisture content) to be used with field density test.

3. Water (Moisture) Content Tests

- a. Determination of water content will be performed in accordance with ASTM D2216. One water content test will be performed for each lift of material. These tests will be in addition to the water content tests performed in conjunction with in-place density tests. Backfill and fills not meeting the required specifications for water content will be retested after corrective measures have been applied.

4. In-place Density Testing

- a. One test per 5,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines. Minimum of 3 test per lift of fill.
- b. One test per 500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines. Minimum of 3 test per lift of fill.
- c. Nuclear density testing equipment will not be used during rain. The density correlations will be submitted with test results. Each transmittal including density test data will include a summary of all density correlations for the job neatly prepared on a summary sheet including at a minimum:
 - i. Test Identification Number.
 - ii. Test location.
 - iii. Station.
 - iv. Coordinates.
 - v. Elevation of Lift.
 - vi. Lift number (if appropriate).
 - vii. Photo number (if appropriate).
 - viii. Meter serial number and operators' initials.
 - ix. Standard count for each test.
 - x. Material type.
 - xi. Probe depth.
 - xii. Moisture content by each test method and the deviation.
 - xiii. Wet density by each test method and the deviation.
 - xiv. Pass/Fail.
 - xv. Retest.
 - xvi. Comments.

5. Additional Testing

- a. The Contracting Officer may request additional tests if there is reason to doubt the adequacy of the compaction, or special compaction procedures are being used, or materials change, or if the Contracting Officer determines that the Contractor's testing is inadequate, or the Contractor is concentrating backfill and fill operations in a relatively small area.

B. Materials

- 1. Suitability of embankment and backfill materials.

C. Fill Placement

1. Layout, maintaining existing drainage, moisture control, thickness of layers, removal of oversized material, spreading and compaction for embankment and backfill.

D. Grade and Cross Section

1. Surveys to verify that the dimensions, slopes, lines and grades conform to those shown on the drawings.

E. Testing by the TPWD

1. During the life of this contract, the TPWD or its Contractors will perform quality assurance tests. Make available to the TPWD or its Contractors the equipment to perform these tests.

F. Reporting

1. On a daily basis, furnish the inspection records and all material testing results, the quantity of fill placed, as well as the records of corrective action taken.

3.8 SLIDES

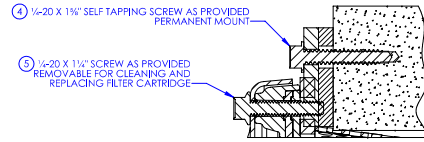
- A. In the event of slides, in any part of the embankment prior to final acceptance of the work, remove material from the slide area, as directed, and rebuild such portion of the embankment. In case it is determined that the slide was caused through the fault of the Contractor, perform the removal and disposal of material and the rebuilding of the embankment without cost to the TPWD; otherwise this work will be paid for at the applicable contract unit prices for excavation and embankment.

END OF SECTION 35 73 13

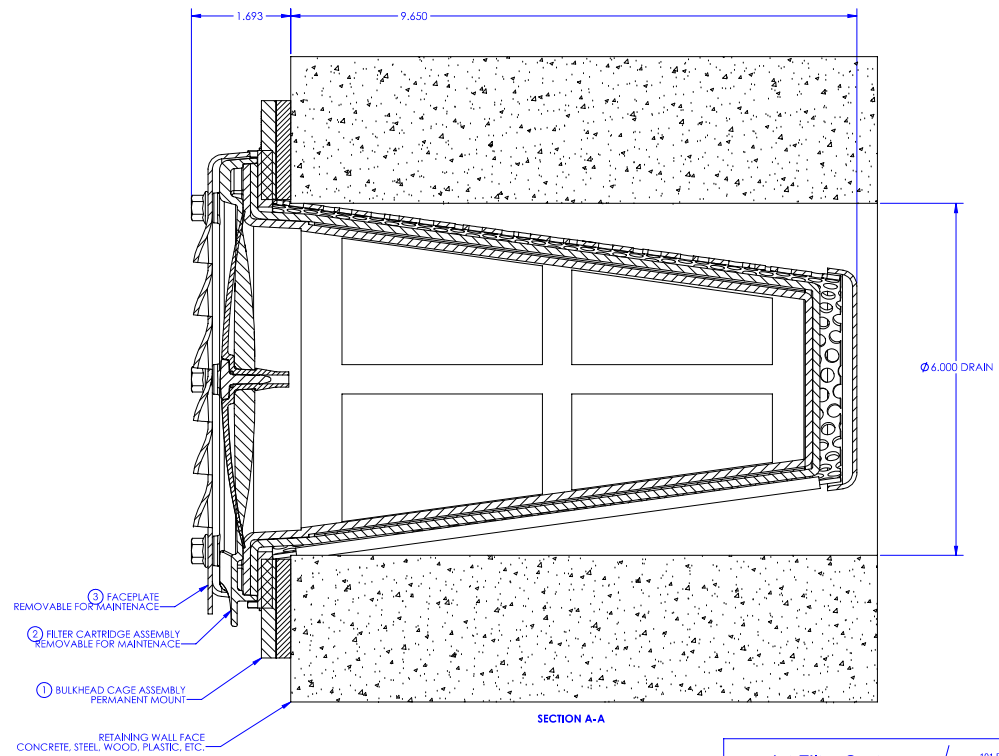
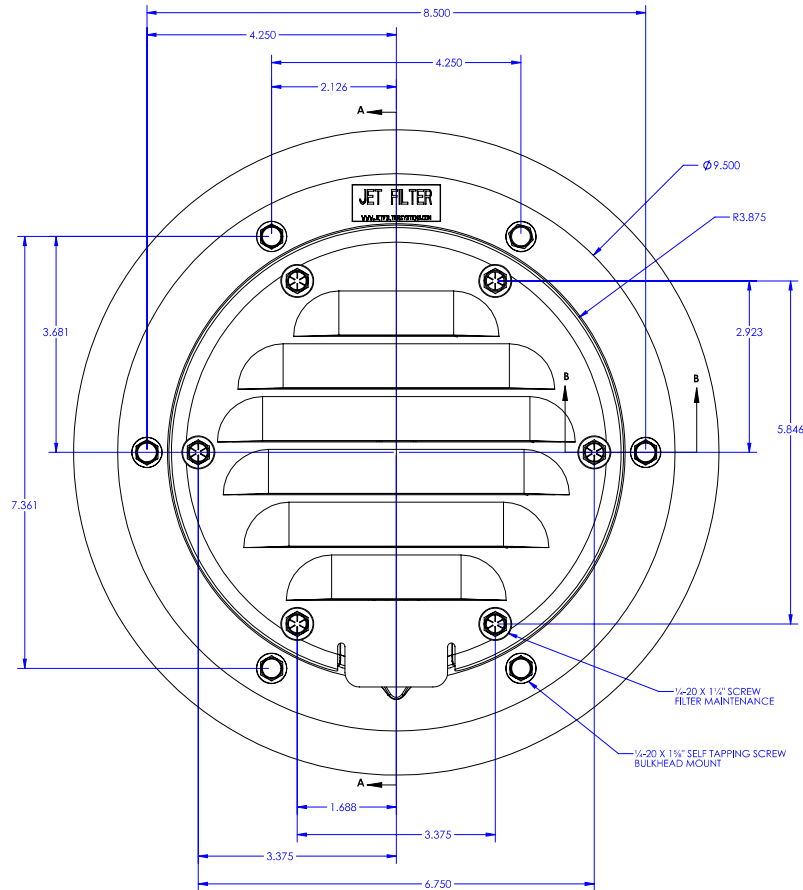
APPENDIX A

CUT SHEETS

REV	DATE	DESCRIPTION	ITEM	NUMBER	DESCRIPTION	QTY
A	2-18-19	INCREASED SCREW LENGTH ITEM 5	1	PD-00283_SS	BULKHEAD GAGE ASSEMBLY	1
			2	EV-10812	FILTER CARTRIDGE ASSEMBLY	1
			3	EV-10791	FACEPLATE	1
			4	1" SCREW	1/20 X 1 1/2" SELF-TAPPING SCREW	6
			5	1" SCREW	1/20 X 1 1/2" SCREW	6



SECTION B-B RECOMMENDED BULKHEAD AND FILTER ASSEMBLY MOUNTING

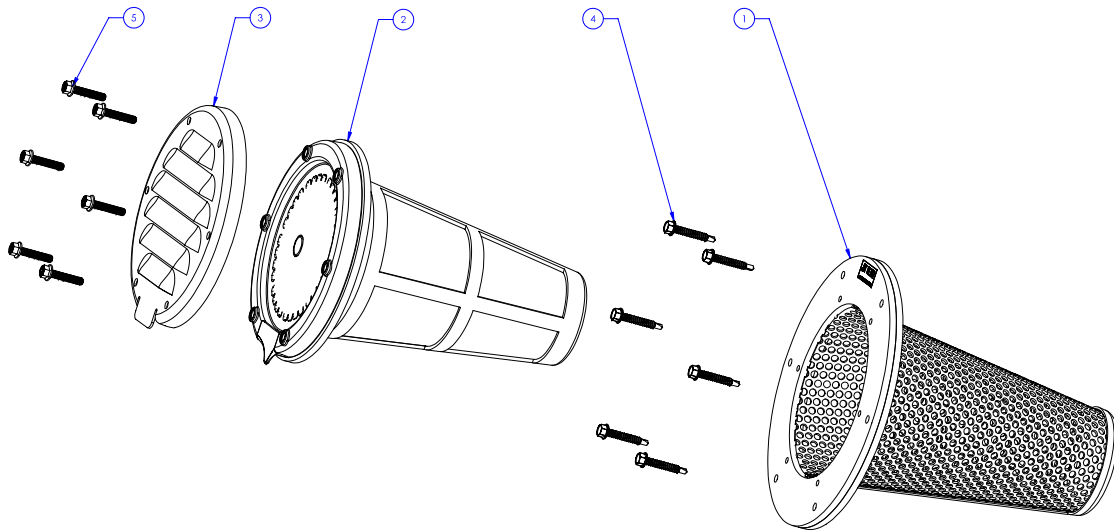


SECTION A-A

Jet Filter System
info@jetfiltersystem.com

101 East Main St.
Ste: C
Casey, IL 62420
800 475-2029

TOLERANCES UNLESS OTHERWISE SPECIFIED				CIVIL CONSTRUCTION				6 INCH JET FILTER		REV. BEL	
2 PLACE	3 PLACE	4 PLACE	ANGLES	FINISHES	DIFFERENCE	SLOPE	1=1	REV.	BEL		
± .005	± .007	± .0005	1:1*	CONCRETE	KCE	ADK	CHRT NO.	PAGE	1		
DEPARTMENTS FROM RETAINED SHEET (ALL OTHERS REMOVED, SQUARED) ETC. MUST BE REVIEWED STARTED PREPARED BY: CIVIL ENGINEER				DATE: 12-10-2019		SHEET: 1 OF 2		JFESS-CV-LV			
DATE: 04-11-2019											

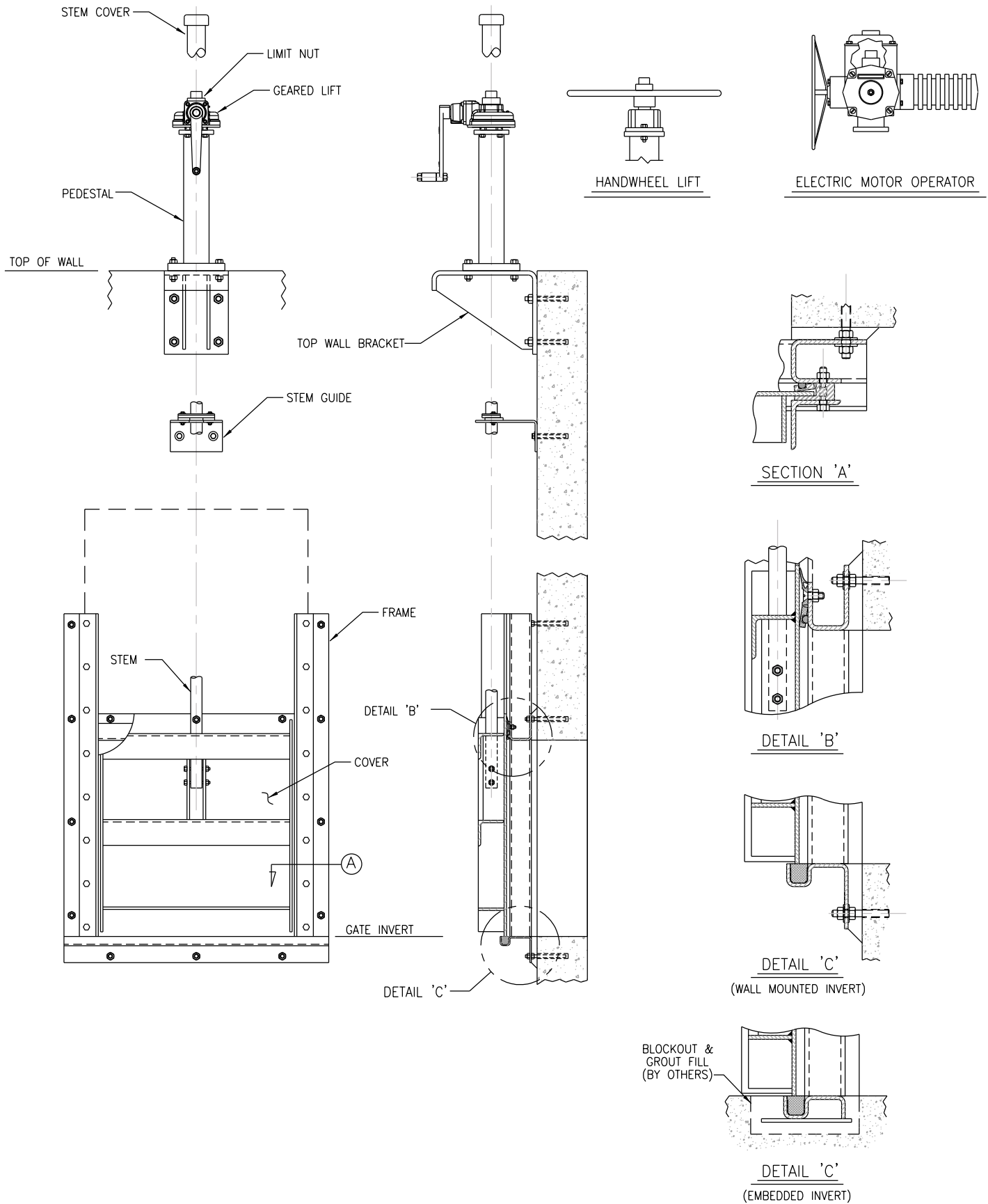


Jet Filter System
info@jetfiltersystem.com

101 East Main St.
Ste. C
Casey, IL 62420
800 475-2029

TOLERANCES UNLESS OTHERWISE SPECIFIED					6 INCH JET FILTER				
1 PLACE	2 PLACE	3 PLACE	ANGLES	OTHER	FINISH	UNIT	REL		
±.005	±.001	±.0005	±.1°		0.006/inch				
DIMENSIONS FROM MOUNTING SURFACE UNLESS OTHERWISE SPECIFIED					DATE	REV	QTY	BY	APP
					12-10-2019	2	2	JFESS-CVCL	1





WATERMAN MODEL SS-251-1
WALL MOUNTED w/GROUT PAD
OPERATOR PEDESTAL TOP WALL MOUNTED

APPENDIX B

GEOTECHNICAL REPORT

**GEOTECHNICAL ENGINEERING
STUDY**

**Phase I – Dam Embankment
And Spillway Improvements
Buescher State Park
Smithville, Texas**

PSI Project No. 0312-1939

PREPARED FOR:

**Halff Associates, Inc.
9500 Amberglen Boulevard
Suite 125
Austin, Texas 78729**

October 5, 2020

BY:

**PROFESSIONAL SERVICE INDUSTRIES, INC.
Three Burwood Lane
San Antonio, Texas 78216
Phone: (210) 342-9377
Fax: (210) 342-9401
Texas Firm Registration No. F-3307**





Professional Service Industries, Inc.
3 Burwood Lane
San Antonio, TX 78216
Office - 210.342.9377

October 5, 2020

Mr. Mike Moya, P.E.
Water Resources Practice Leader
Halff Associates, Inc.
9500 Amberglen Blvd., Suite 125
Austin, Texas 78729

RE: Geotechnical Engineering Study
**Phase I –Dam Embankment &
Spillway Improvements**
Buescher State Park
Smithville, Texas
PSI Project No.: 0312-1939

Dear Mr. Moya,

Professional Service Industries, Inc. (PSI), an Intertek company, is pleased to submit our Geotechnical Engineering Report for the above referenced project. This report includes the results of field and laboratory testing along with geotechnical observations for this project. This report addresses the Preliminary Design elements provided by Halff Associates, Inc. at this time and is therefore considered Conceptual. PSI will provide a Final Design report for the project once the design has been finalized by the Design Team.


We appreciate the opportunity to perform this Geotechnical Engineering Study and look forward to continuing participation during the design phase of this project.

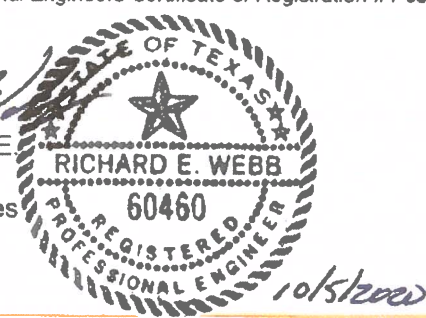
If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Texas Board of Professional Engineers Certificate of Registration # F003307


Richard E. Webb, P.E.
Principal Consultant
Geotechnical Services




Kevin C. Miller, P.E.
Chief Engineer

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APPENDIX A

Vicinity Map
Boring Location Plan
Boring Logs
Symbol Key Sheet
Direct Shear Laboratory Test Results

APPENDIX B

Global Stability Results

APPENDIX C

Conceptual Dam Design

APPENDIX D

Embankment Seepage Analysis
Spillway Structure Seepage Analysis

1.0 PROJECT INFORMATION

1.1 Project Authorization

Professional Service Industries, Inc. (PSI) previously completed preliminary geotechnical engineering reports for the conceptual dam embankment and spillway improvements entitled *Phase I – 30% Dam Embankment and Spillway Improvements, Buescher State Park, Smithville, Texas* dated March 4, 2020 and *Phase I – 50% Dam Embankment and Spillway Improvements, Buescher State Park, Smithville, Texas* dated May 5, 2020. This report is the design-level geotechnical engineering report and supersedes the previous reports.

Mr. Mike Moya, P.E. representing Halff Associates, Inc. (Halff), authorized our services through Halff Standard Subcontract for Subsurface/Underground Services (Halff Project Number 36506.001) dated September 27, 2019. The work was performed in accordance with PSI Proposal No. 272375 dated March 18, 2019.

1.2 Project Description

PSI understands that the dam was constructed in 1936 as an earthen dam with a “puddled” clay core. The spillway structure is located directly east of the existing dam and is separated from the earthen dam with a retaining wall that also functions as a spillway training wall. PSI also understands that a breach occurred on the earthen dam directly west of the spillway and was subsequently repaired in 1993.

Halff has provided PSI with the following documents:

- As-Built documents of the existing dam dated 1936.
- As-Built documents for the dam repair performed in 1993.
- A TCEQ inspection report on the dam dated April 8, 2016.
- A report entitled *Phase I Geotechnical Investigation, Buescher State Park Dam, Smithville, Texas*, prepared by Trinity Engineering Corporation dated August 28, 1992.

At the time of the 2016 TCEQ report, scouring had occurred downstream of the spillway. More recent rain events, including Hurricane Harvey, had caused greater scour and significant distress of the downstream portion of the spillway. The scour features generally consisted of stair-stepped failures of approximately 6- and 15-foot depths, and two erosion channels to the south of the spillway.

The downstream portion of the spillway was heavily vegetated with large mature trees and brush. At the previous scour failure locations, root systems could be seen that extended below the existing spillway slab. The scour also caused several trees to fall. Water seepage was also observed below the cemented stone in the scour areas. Recent repairs have improved the flow, but still includes trees in the spillway channel at the Park’s request.

To help rehabilitate the spillway damage, PSI was retained to provide geotechnical engineering services for the general site assessment of the existing spillway with regard to short- and long-term rehabilitation alternatives. The results of our services were presented in two reports:

- *Proposed Dam Spillway Rehabilitation – Phase I*, PSI Project No. 0312-1564, dated November 7, 2017, and
- *Proposed Dam Spillway Rehabilitation – Phase II*, PSI Project No. 0312-1564, dated December 13, 2017.

The short-term rehabilitation of the spillway was completed in December 2019.

PSI understands that long-term rehabilitation of the dam embankment and spillway will include raising the top elevation of the dam embankment approximately 5 feet, which is close to the original design elevation, and reconstructing the existing spillway. The proposed improvements for the dam embankment will be raised by constructing toe buttress and toe drain at the downstream toe of the existing embankment and adding to the downstream face of the existing slope. The new spillway will be enlarged from the existing, extending further to the west and will likely consist of a staged spillway, designed by others, with various elevations for varying storm events (e.g. 1-year and 75% PMF). The spillway will also include lateral retaining walls, stilling basin with baffle blocks and training walls to convey water flowing over the spillway and redirecting the flow into the natural channel located down-stream of the dam.

It is understood that Halff & Associates, Inc. is providing the design services for this project as the consultant for Texas Parks and Wildlife Department.

1.3 Purpose and Scope of Services

The purpose of this study is to evaluate the subsurface conditions at the site and develop geotechnical engineering recommendations and guidelines for use in preparing the design and other related construction documents for the proposed dam embankment and spillway improvements. The scope of services included drilling test borings, performing selected laboratory tests, and preparing this geotechnical engineering report. The following describes the scope of services that were included in our exploration:

- Document general soil and phreatic conditions in the embankment;
- Comments on the existing dam earthen embankment condition and proposed geotechnically-related modifications;
- Reviewing previous geotechnical studies and geological information at or near the project area;
- Sampling and testing the subsurface materials and observing groundwater conditions;
- Identifying the pertinent static physical and engineering characteristics of subsurface materials encountered during the sampling and testing through a laboratory testing program. The testing program included advanced laboratory tests to identify soil long-term drained parameters;
- Providing a description of the subsurface conditions and boring logs presenting soil stratigraphy at the exploration locations, and test data from field and laboratory procedures;
- Conceptual cross-sections of dam and slopes;
- Assignment of typical strength soil parameters based on available data and borings performed at this time;
- Recommendations for spillway structure construction, including foundation bearing capacities, anchor pullout capacities to counteract uplift, and assess seepage conditions;
- Recommendations for additional dam embankment fill and foundation materials; discussions on general seepage and downstream slope drainage, global stability and expected settlement of the dam due to alterations;
- Perform slope stability to verify stability of existing and proposed embankment slopes and assist in identifying critical areas to be explored and identified;
- Earthwork recommendations;

- Engineering workshop participation and embankment design review;
- On-site engineering observation; and
- Collaborate with Halff and TPWD on findings and improvement concepts.

The proposed exploratory boring program also included borings in a proposed potential borrow area. The borrow area has not been finalized at this time and therefore, future study for the proposed borrow area will include soil borings, associated laboratory testing and engineering analyses and recommendations as required.

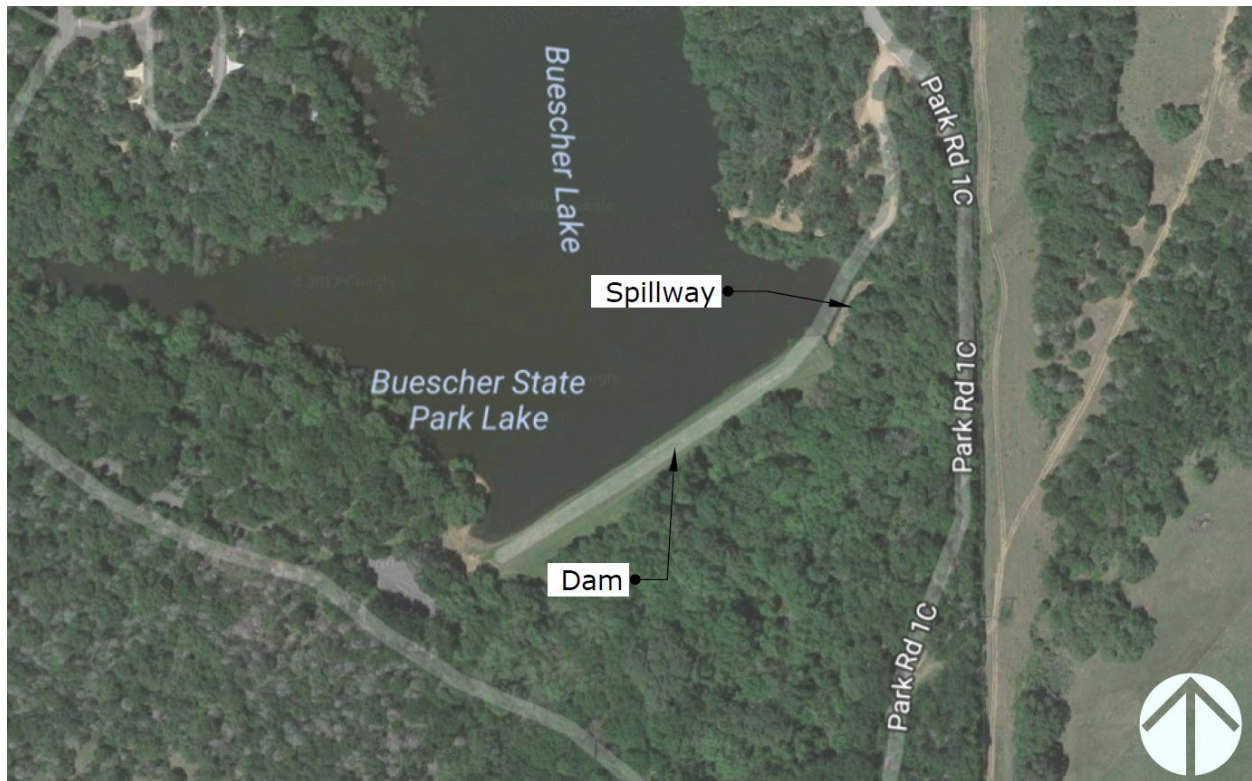
The scope of services for this subsurface exploration did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 Site Description

PSI understands that the existing Buescher State Park Dam experienced significant scour at two primary locations of the downstream portion of the spillway with a third area that developed in-between the two primary scours. The dam was constructed in 1936 as an earthen dam with a puddled clay core. A site vicinity map is included under Appendix A. The spillway structure is located directly east of the existing dam and is separated from the earthen dam with a retaining wall. PSI also understands that a breach occurred on the earthen dam immediately west of the spillway which was repaired in 1993. The figure below depicts the approximate location of the dam and spillway structures.

Figure 1 – Approximate Site Location, N 30.0418 W -97.1591



Based on information provided by Halff, PSI understands that scouring was present at the spillway downstream area at the time of the 2016 TCEQ report and further rain events, including Hurricane Harvey in August of 2017, enlarged the scour fractures and initiated partial failure of the spillway structure. The major scour consisted of stair-stepped failures of approximately 6- to 15-foot depth, and the onsite materials have washed away creating two erosion channels to the south of the spillway.

To help rehabilitate the spillway damage, short-term rehabilitation of the spillway was undertaken and completed in November 2019. The rehabilitation consisted of placing grouted rip rap downstream of the spillway in the areas of the previous scour and removal of trees and debris in the downstream channel. The following photographs illustrate these short-term rehabilitation efforts downstream of the spillway.

Figure 2 – Rehabilitation Looking Downstream



Figure 3 – Rehabilitation Looking Upstream



Following the short-term remediation efforts, a long-term remediation of the spillway and dam embankment is being undertaken and is the subject of this report.

The geotechnical recommendations presented in this report are based on the available project information, structure locations, and the subsurface materials described in this report. If any of the noted information or assumptions made are incorrect, please inform PSI so that the recommendations presented in this report can be amended as necessary. PSI will not be responsible for the implementation of provided recommendations if not notified of changes in the project.

2.2 Site Geology

As shown on the Geologic Atlas of Texas, Austin Sheet (1974), the site is located in an area where the **Weches Formation (Ew)** formation is present at or near the ground surface. The Weches Formation is composed of Greensand, Sand and Clay. The sand has a pale green to yellowish brown color. The clay weathers from dark brown to reddish brown. The Weches Formation has been measured to have a thickness of 50 feet.

2.3 Field Exploration

Field exploration in the area of the spillway and dam embankment consisted of drilling four (4) test borings. Boring B1 and B2 were drilled at the top of the embankment to a depth of about 50 feet below existing grades. These borings were offset about 8 to 10 feet off the centerline of the embankment to encounter the predominant materials of the existing dam, and not the clay puddle core. Boring B3 was located near the toe of the dam and near the west end by the canoe rental area. Due to access limitations, B3 was not completely at the toe of the embankment, but within about 10 to 15 feet of the toe. Finally, Boring B4 was completed immediately upstream of the existing spillway. The lake level had been lowered several feet and thus access upstream of the spillway was available. The test boring locations were selected by PSI and were located in the field by a PSI representative using a handheld GPS device. The approximate test boring locations are shown on the Boring Location Plan provided in Appendix A.

The test borings were drilled using an ATV rig (buggy rig) and continuous-flight auger methods were used to advance the test holes. Undisturbed cohesive samples were recovered by hydraulically pushing a 3-inch diameter Shelby Tube in general accordance with ASTM D1587. Granular and disturbed cohesive samples were obtained using the Standard Penetration Test (SPT) in general accordance with ASTM D1586. The SPT N-values are recorded on the boring logs in Appendix A.

The samples obtained from the test borings were identified according to test boring number and depth, and a representative portion of each sample was sealed in plastic to protect against moisture loss. The samples were subsequently transported to PSI's laboratory in San Antonio, where they were examined by a Geotechnical Engineer and were visually classified using the Unified Soil Classification System.

2.4 Laboratory Testing Program

PSI supplemented the field exploration with a laboratory testing program to determine engineering characteristics of the subsurface soils encountered. The laboratory testing program included:

- Moisture Content (ASTM D2216)
- Atterberg Limits (ASTM D4318)
- Percent Passing No. 200 Sieve (ASTM D1140)
- Unconfined Compressive Strength (ASTM D2166) (including dry density)

- Direct Shear of Soil Under Consolidated-Drained Conditions (ASTM D3080) (including density)

The laboratory results are reported in the attached boring logs included in Appendix A. The soil laboratory testing for this project was performed in general accordance with applicable ASTM procedures. Laboratory tests will also be performed on the borrow material to determine material characteristics and shear strength of the re-molded soils used to raise the embankment height of the dam.

2.5 Subsurface Conditions

The results of our field and laboratory testing indicates the borings in the embankment area (B1 & B2) for the full exploration depth of 50 feet are primarily composed of alternating layers of sandy clay and clayey sand overlying weakly cemented sandstone with occasional clay seams, as summarized in the following table:

Table 2.1 – Subsurface Conditions B1 & B2

Layer	Depth of Layer (ft)		Soil Type	ω (%)	LL (%)	PL (%)	PI	% Pass #200
	Top	Bot.						
1	0	18.5-48.5	Sandy Fat to Lean Clay (CH-CL) Clayey Sand (SC)	8-23 6-24	43-54 22-71	14-22 13-27	29-32 3-45	52-58 23-47
2	18.5-48.5	50	Weakly Cemented Slightly Clayey to Clayey Sandstone	18-25	27-50	17-22	7-41	16-36

1. ω –Water Content (%)
2. LL –Liquid Limit (%)
3. PI –Plasticity Index
4. % Pass. #200 –Material Passing the No. 200 Sieve (%)

The results of our field and laboratory testing indicates the boring at the toe of the slope on the west end of the dam (B3) for the full exploration depth of 30 feet are primarily composed of sandy clay and clayey sand overlying silty sand with intermittent clay seams as summarized in the following table:

Table 2.2 – Subsurface Conditions B3

Layer	Depth of Layer (ft)		Soil Type	ω (%)	LL (%)	PL (%)	PI	% Pass. #200
	Top	Bot.						
1	0	18	Sandy Clay (CL & CH) and Clayey Sand (SC)	9-21	45-55	19-25	22-35	39-60
2	18	30	Silty Sand (SM) with clay seams	13-24	29	19	10	37

1. ω –Water Content (%)
2. LL –Liquid Limit (%)
3. PI –Plasticity Index
4. % Pass. #200 – Average Material Passing the No. 200 Sieve (%)

The results of our field and laboratory testing indicates the soils encountered in the boring at the front of the spillway (B4) are primarily composed of clayey sand overlying weakly cemented sandstone with intermittent sandy clay seams extending to 30 feet (the depth of the boring) as summarized in the following table:

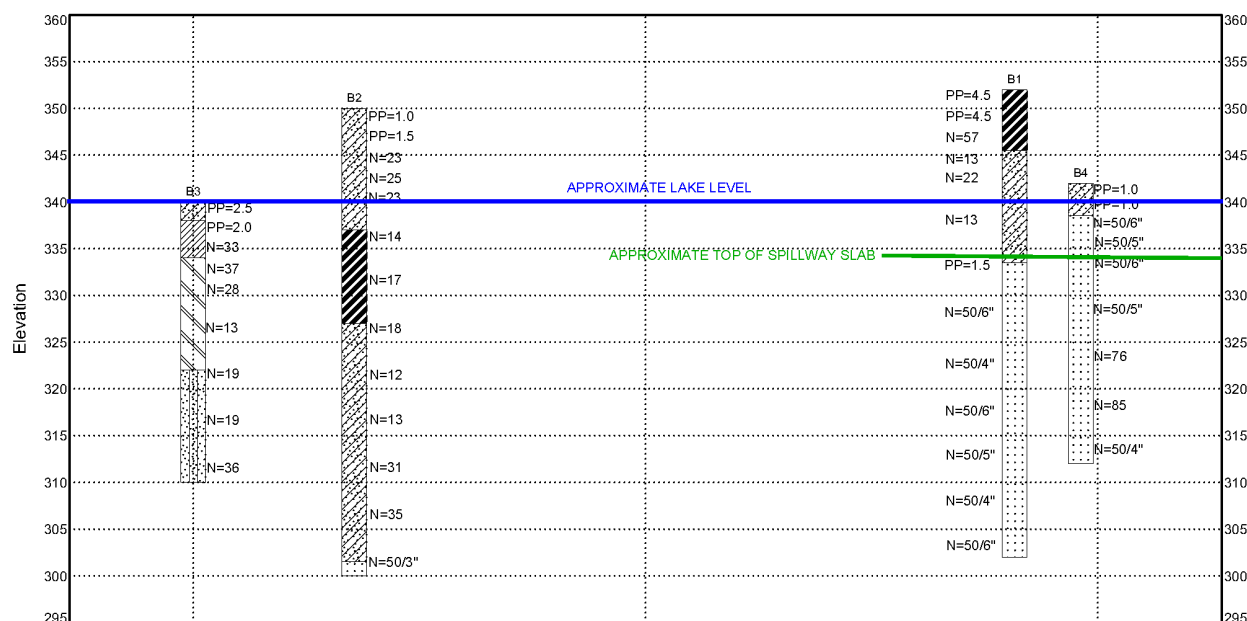
Table 2.3 – Subsurface Conditions B4

Layer	Depth of Layer (ft)		Soil Type	ω (%)	LL (%)	PI	% Pass. #200
	Top	Bot.					
1	0	4	Clayey Sand (SC)	18-25	--	--	47
2	4	30	Weakly Cemented Slightly Clayey to Clayey Sandstone	10-25	--	--	18-32

1. ω –Water Content (%)
2. LL –Liquid Limit (%)
3. PI –Plasticity Index
4. % Pass. #200 – Average Material Passing the No. 200 Sieve (%)

The boring logs have detailed description and lab results for the encountered soils. The following diagram displays the subsurface profiles at the four locations along the dam embankment. The figure displays blows per foot (N-value) and pocket penetrometer readings (PP in tsf).

Figure 4 – Subsurface Fence Diagram (West to East)



The subsurface descriptions are of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs should be reviewed for specific information such as soil descriptions, stratifications, penetration resistances, locations of the samples, and laboratory test data at each individual boring location.

PSI's geotechnical engineer prepared the boring logs using stratigraphic and soil property data developed during our field and laboratory programs. Each log represents our interpretation of general soil and water conditions at the boring location. PSI used the Unified Soil Classification System (ASTM D2487) to classify the recovered soils. The boring logs are included in Appendix A. A key to the terms and symbols used on the logs are included at the end of the boring logs.

The stratifications shown on the boring logs only represent the conditions at the actual boring location and represent the approximate boundaries between subsurface materials. The actual transitions between strata may be more gradual or more distinct. Variations will occur and should be expected at locations between and away from the boring locations. Water level observations made during field operations are also shown on the boring logs. The indicated stratum depths and any water levels are measured from the ground surface and are estimated to the nearest one-half (½) foot.

2.6 Phreatic Surface Information

Water level measurements were performed during drilling and after completion of drilling. Specific information concerning the phreatic surface is noted on each boring log presented in Appendix A of this report. The phreatic surface measurements are summarized in the following table.

Table 2.4 – Phreatic Surface Elevations

Boring Designation	Boring Depth (feet)	Approx. Boring Elevation (feet)	During Drilling, Depth / Elevation (feet)	After Drilling, Depth / Elevation (feet)
B-1	50	352	28 / 324	26 / 326
B-2	50	350	23 / 327	23 / 327
B-3	30	340	28 / 312	28 / 312
B-4	30	342	18 / 324	17 / 325

The elevation of the lake at the time of drilling was not measured. However, based on photographs taken during drilling, the estimated elevation of the lake is approximately 341 feet. At the time of drilling operations, Texas Parks and Wildlife department were operating a siphon.

Phreatic surface levels are influenced by pool elevation, seasonal, and climatic conditions which generally result in fluctuations in the elevation of the phreatic surface over time. In relatively impervious soils, water levels observed in the test borings even after several days may not provide reliable indications of groundwater table elevations.

3.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

This section includes information to be used in the dam improvement design. PSI has reviewed available project information, previous geotechnical studies and our borings with laboratory test results to develop a conceptual dam design. Mr. Kevin Miller, with PSI, has been involved in project team discussions with Mr. Paul Morales with Halff Associates and their Design Team to assist in developing conceptual designs for preliminary cost purposes. The following sections include information considered for our conceptual design and preliminary design calculations.

3.1 Review of Available Information

PSI reviewed the following documents in preparation of this Geotechnical Report.

Table 3.1 – Available Documents Reviewed

Document Name	Source	Date
Design and Construction Guidelines for Dams in Texas	TCEQ	August 2009
Inspection Report of Buescher Dam	US Department of the Interior	March 11, 1941
Bastrop – Buescher Recreational Dam – Plan, Section & Details, Sheet 3 of 3	Texas State Parks Board – US Dept. of the Interior	November 22, 1935
Buescher State Park Lake Dam – 2016 Inspection	TCEQ	April 8, 2016
Site Assessment Report for Buescher State Park Lake Dam	HALFF	February 26, 2018
Preliminary Dam Improvements – Sheets 1-3	HALFF	November 11, 2019

3.2 Geotechnical Evaluation

The following geotechnical related evaluation has been developed based on the subsurface conditions encountered and PSI's understanding of the proposed development. Should changes in the project criteria occur, a review should be made by PSI to determine if modifications to our evaluation requires further study.

The four primary physical parameters controlling the construction of an earthen dam are listed below.

1. External and internal geometries
2. Shear strength at different phases of construction and operation
3. Compressibility of the dam and foundation soils
4. Permeability of the dam and foundation materials

In the evaluation of an earthen dam there are four separate internal shear strength conditions that are typically evaluated with different external loads. These conditions are:

1. End-of-Construction (Short-Term)
2. Steady State Seepage (Long-Term)
3. Rapid Drawdown (up-stream only)
4. Earthquake

In the End-of-Construction condition, the foundation and embankment materials are evaluated based on what is termed Undrained or Total Stress parameters. This basically means that the soils are evaluated as though the entire dam embankment modifications were placed instantaneously on the existing dam embankment with no apparent changes in the physical properties of the existing soils. That can also be defined as the existing dam soils having the same general strength after the dam modification are constructed as it did before construction began. This is conservative because once construction begins the foundation soils tend to compress or consolidate resulting in a higher strength. Because the rate of consolidation of many soils are often slower than the rate of construction, the exact increase in strength is typically variable throughout the thickness of the existing soils and therefore the pre-existing soil strengths are used for these analyses. This also means that a portion of the embankment modification loads may be carried by hydraulic pore water pressure in the soil matrix until full consolidation occurs from the applied loads.

In the Steady State Seepage condition, the existing dam and modified embankment materials are evaluated based on what is termed Drained or Effective Stress parameters. This basically means that the soils are evaluated as though the dam modifications have been in place for an extended period of time, the consolidation of both the existing dam and modified embankment soils have taken place and the flow of water through the dam from the long-term sustained reservoir has established a constant level through the modified structure. It can take years for this condition to take place in many earthen dams. In this soil condition, the buoyant (or effective) loads on the soils are carried by the soil matrix alone. In this report we have looked at the steady-state case for the proposed dam embankment improvements. This evaluation documents the feasibility of the proposed dam embankment improvements. The other load conditions will be analyzed for the final configuration and identified building materials.

Dams are also evaluated for a Rapid Drawdown condition. This condition is typically defined as a dam that has reached the Steady State Seepage or long-term condition where the water level in the reservoir is dropped in rapid fashion. The rapid fashion is in terms of the permeability of the soil and could represent hours or days. This condition is analyzed on the basis that the modified dam and foundation materials have fully consolidated under their effective or buoyant loads, but are evaluated on the basis of Undrained or Total Stress parameters because the water cannot flow out fast enough to adjust to the changed hydrostatic loading condition within the saturated portion of the dam.

Finally, the earthquake condition is evaluated using a pseudo-static form of analysis where the horizontal and vertical components along a potential sliding surface are evaluated with a coefficient multiplier related to an averaging of the peak accelerations that are expected to occur during a probabilistic determined earthquake event. Earthquake parameters are minimal in the project location, but they are provided for design consideration. Based on ASCE 7-16, The PGA_u for this location is 0.045g, therefore, a pseudo static coefficient of 0.05g should be conservative for this location.

3.3 Dam Classification

A TCEQ Dam Safety Inspection Report dated April 8, 2016, was provided to PSI. The field inspection determined “the dam was found to be in overall poor condition primarily due to the condition of the spillway, which was undermined and deteriorating downstream of the crest.” The recently completed rehabilitation of the spillway and downstream channel addressed these conditions as a temporary solution until the spillway is reconstructed and is the subject of this study. Halff also provided PSI with a technical memorandum entitled *Site Assessment Report for Buescher State Park Lake Dam*. The existing drainage area to Buescher State Park Lake Dam is approximately 1.57 square miles. The Dam is classified as “significant hazard” per the *TCEQ Chapter 299 – Dams and Reservoir, Subchapter B: Design and Evaluation of Dams*. The Dam height is about 26 feet with a maximum storage of 230 acre-feet. The minimal design flood for the “small sized, significant hazard”

classification is 50% of the Probable Maximum Flood (PMF). Halff conducted a Hydrologic Analysis determined that the existing structure is only capable of passing approximately 10% PMF.

The TCEQ Dam Safety Inspection Report recommends that “a rebuilt dam structure should likely have to safely pass 75% of the PMF, unless a breach analysis warrants lesser design storm requirements.” This would set the proposed dam category as “low sized, high hazard.”

This report includes a discussion of the dam design for this site. The basis for this discussion is the publication, “Earth Dams and Reservoirs”, originally published by the U.S. Department of Agriculture, Washington D.C., in October 1985. The following discussion follows the general outline given in this publication for designing and evaluating dams.

3.4 Conceptual Dam Improvements

PSI recommends that the dam improvements be designed with 4H:1V slope for the upstream and 3H:1V for the downstream section. After discussions between PSI and the Project Design Team, the following general dimensions for the proposed dam have been developed and are shown below.

Figure 5 – Proposed Dam Embankment Improvements

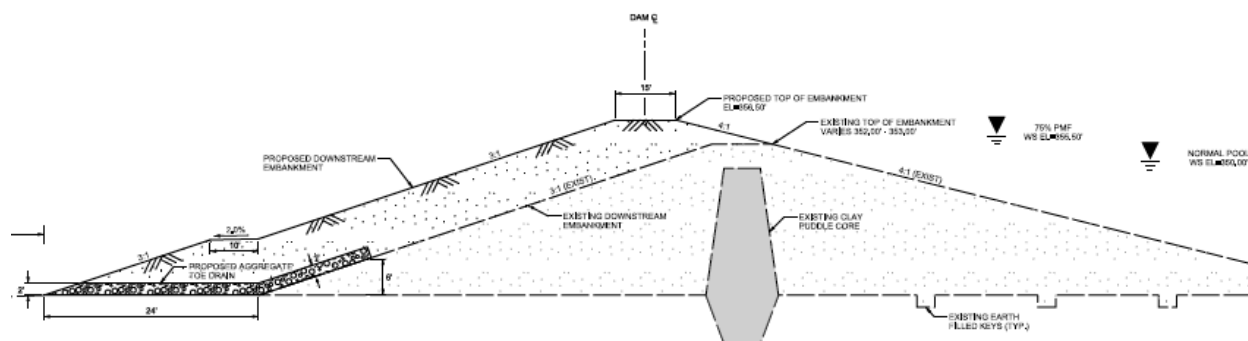


Table 3.2 – Proposed Dam Embankment Dimensions

Dam Element	Proposed Dimension of Dam Element
Downstream Slope	3H:1V
Approximate Height from the Downstream Toe to the Crest	23.5 feet
Width of Crest	15 feet
Approximate Elevation of Crest of Dam	356.5 feet
Upstream Slope	4H:1V
Aggregate Toe Drain	25 feet to 50 feet wide to be placed at selected low points along the embankment

As shown in Figure 2, the proposed dam design is composed of several types of materials. The new embankment fill can be composed of imported borrow materials with a Plasticity Index < 25 and a Passing No. 200 Sieve > 15%.

3.5 Drainage Considerations

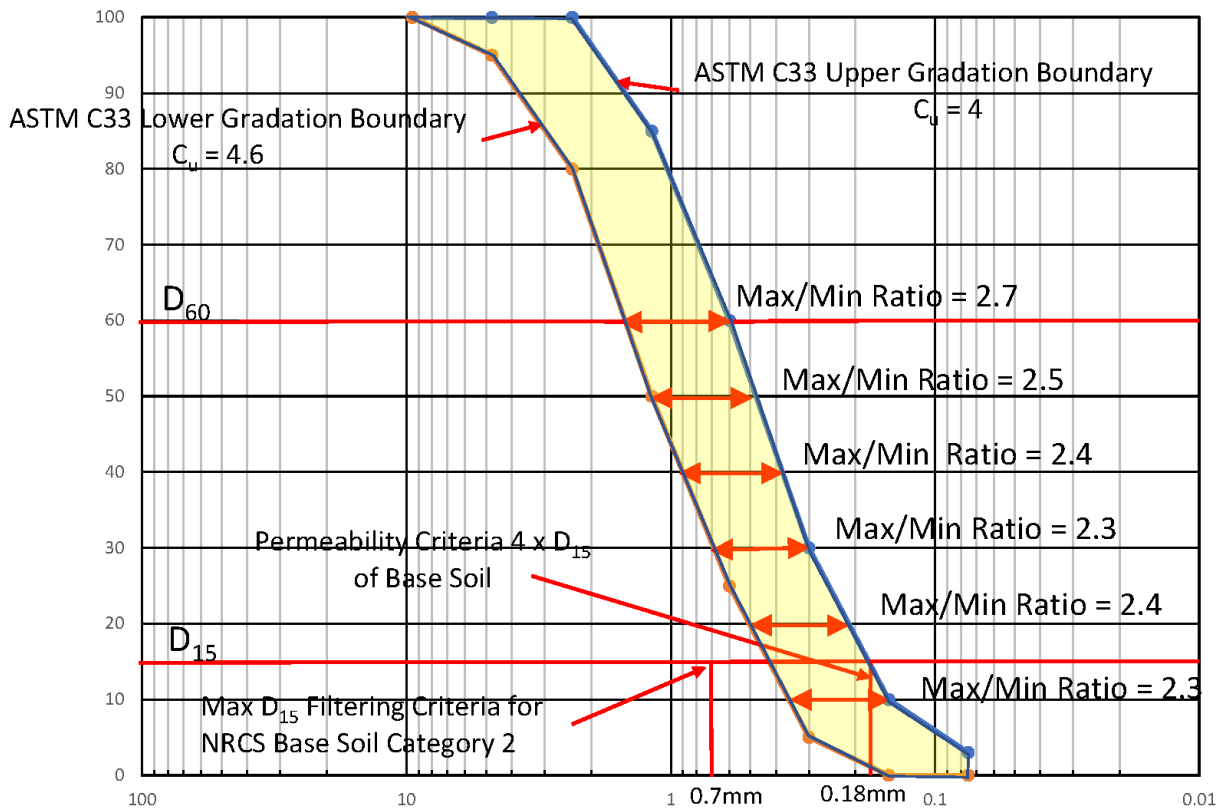
PSI recommends that a granular drainage system be implemented adjacent to the existing embankment along the downstream toe with several intermittent blanket drains 25 to 50 feet wide extending up the existing embankment approximately 13 ½ feet (6 feet vertically). The blanket drains should be placed at the low elevation areas along the toe located at approximately Stations 4+25, 6+00 and 7+50.

The toe and blanket drains should have a minimum thickness of 36 inches. To determine the gradation requirements of the granular materials, PSI used the NRCS filter drain criteria summarized in the following table and figure. Based upon our evaluation, the gradation of the drainage aggregate should meet ASTM C33 Fine Aggregate which is a readily available commercial material.

Table 3.3 - Subsurface Material Strength Parameters

NRCS Design Consideration	NRCS Design Criteria	PSI Evaluation Results
Base Soil % Finer No. 200 Sieve	Approximately 50%	NRCS Base Soil Category 2
Filtering Criteria - Maximum D_{15}	≤ 0.7 mm for Base Soil Category 2	D_{15} of ASTM C33 Fine Aggregate 0.18 to 0.42 mm
Permeability Criteria	$\geq 4 \times D_{15}$ of Base Soil	D_{15} of Base Soil is Finer than No. 200 Sieve (0.075 mm). 4×0.075 mm (D_{50}) = 0.3 mm (the average D_{15} of ASTM C33 Fine Aggregate)
Prevention of Gap-Grade Filter	Width of Design Filter Band - Ratio of Maximum to Minimum Diameters of Sieves with 60% or less Passing ≤ 5	Ratio of Max Diameter to Min Diameter for the Filter Band with 60% Passing is approximately 2.5 or less
Filter Band Limits	Coarse and Fine Limits of Filter Band $C_u \leq 6$	C_u Coarse and Fine Limits of ASTM C33 Fine Aggregate is approximately 4

Figure 6 –Granular Drainage Section



The following figure displays the recommended drainage section.

Figure 7 –Granular Drainage Section



A collection pipe is not required to transport water collected by the toe and blanket drains. The drain should be sloped to facilitate transporting the collected water to a suitable outlet and away from the embankment. If desired, a 6-inch slotted or performed collector pipe can be installed within the drainage sand.

3.6 Geotechnical Strength Parameters

The following table displays the generalized subsurface stratum with material strength parameters based on field and laboratory testing, empirical correlations and our experience with similar soils.

Table 3.4 - Subsurface Material Strength Parameters

Material Type	Soil Total Unit Weight	Short Term (Undrained) Parameters	Long-Term (Drained) Parameters
Existing Materials Onsite			
New Embankment Fill	$\gamma = 128 \text{ pcf}$	$c = 1500 \text{ psf}$ $\phi = 0^\circ$	$c' = 0 \text{ psf}$ $\phi' = 37^\circ$
Existing Embankment	$\gamma = 126 \text{ pcf}$	$c = 650 \text{ psf}$ $\phi = 0^\circ$	$c' = 0 \text{ psf}$ $\phi' = 31^\circ$
Existing Embankment (Saturated)	$\gamma = 128 \text{ pcf}$	$c = 650 \text{ psf}$ $\phi = 0^\circ$	$c' = 0 \text{ psf}$ $\phi' = 31^\circ$
Existing Clay Core	$\gamma = 122 \text{ pcf}$	$c = 395 \text{ psf}$ $\phi = 0^\circ$	$c' = 0 \text{ psf}$ $\phi' = 16^\circ$
Native Bearing Soils	$\gamma = 128 \text{ pcf}$	$c = 1080 \text{ psf}$ $\phi = 0^\circ$	$c' = 0 \text{ psf}$ $\phi' = 33^\circ$
Granular Toe Drain	$\gamma = 110 \text{ pcf}$	$c = 0 \text{ psf}$ $\phi = 34^\circ$	$c' = 0 \text{ psf}$ $\phi' = 34^\circ$

3.7 Slope Stability Analysis

Slope stability analyses were included as part of the 30% Dam Embankment Design. The analyses were performed using the information obtained from the soil test borings and laboratory testing drilled as part of this exploration.

The slope stability analyses were conducted using *Slide 2018* from Rocscience, Inc. PSI performed the analyses considering Long-Term (drained) strength conditions for the downstream slope to check our conceptual design. Consolidated-Undrained total stress parameters for the rapid drawdown model were estimated by taking the effective stress envelopes and shifting them until they intercepted a 45-degree stress path line. The envelope was then measured from the relocated Mohr circles. Survey data obtained from Halff and our conceptual Dam design was utilized to create a model in the computer program.

The analysis results are included in Appendix B. Conservative material strength properties based on the available geotechnical data was used in our model. The earthquake model used a pseudo-static seismic coefficient of 0.05g. The following table summarizes the results from the stability analyses performed for this report:

Table 3.5 - Subsurface Material Strength Parameters

Type of Analysis	Location	Results	TCEQ Requirement
End of Construction – Total Stress parameters	Downstream	2.02	1.25
Long Term – Effective Stress parameters	Downstream	2.02	1.5
Earthquake – Effective Stress parameters	Downstream	1.73	1.0
Long Term – Effective Stress parameters	Up-Stream	2.10	1.5
Earthquake – Effective Stress parameters	Up-Stream	1.67	1.0
Rapid Drawdown – Consolidated Total Stress	Up-Stream	1.46	1.2
Sliding Analysis – Steady State	Spillway	2.13	1.5
Sliding Analysis - Earthquake	Spillway	1.64	1.0

The factor of safety of 2.02 shown above for the Downstream End of Construction and Long-Term analyses are unique to a short slide surface at the toe. The remaining surfaces for each case are quite different. The calculated factors of safety exceed the State requirements.

3.8 Seepage

A properly designed filter-drainage zone will help lower the development of concentrated leaks through cracks or holes in the dam. The above stability analyses were performed using a phreatic surface that neglects the effects of the puddled clay core. The puddled clay core should lower the phreatic surface on the downstream portion of the dam because the consolidated clay should have a lower permeability than the surrounding soils. Therefore, neglecting the effects of the puddled clay core is a conservative approach to the stability analyses.

Based upon the proposed depths of the spillway structure and retaining wall foundations, these new structures will be likely be supported on the underlying weakly cemented sandstone. Therefore, the need for a cut-off wall to reduce seepage beneath the spillway structure is not considered to be necessary.

3.8.1 Embankment

The seepage through the embankment was evaluated using the graphical flow net presented in the Appendix. The seepage was evaluated neglecting the effects of the puddled clay core within the existing embankment. The lower permeability of the puddled clay core should lower the phreatic surface on the downstream portion of the embankment and reduce the seepage flowrate through the dam. Based upon our analyses, the seepage flowrate through the embankment will be approximately 10 gallons per day/foot of embankment. The seepage will be collected in the granular drainage blanket and drain located at the downstream toe of the embankment and transported to a drainage outlet near Station 4+00 along the centerline of the crest.

3.8.2 Spillway Structure

The seepage within the weakly cemented sandstone underlying the spillway structure was evaluated using the Method of Fragments as presented in *Groundwater and Seepage* by Milton E. Harr (2011). The results of the analyses are presented in the Appendix. Based upon the analyses, a total seepage flowrate of approximately 1,500 gallons per day was estimated across the width of spillway structure.

PSI has reviewed the report entitled Hydraulic Assessment Report for Buescher State Park Lake Spillway (50% Design) prepared by Doucet & Associates, Inc. dated August 3, 2020. Based upon the information presented in the report, the uplift pressures presented in the report are considered appropriate for design of the spillway.

3.9 **Embankment Materials and Compaction**

The existing embankment materials generally consist of clayey sand and sandy clay. Based upon review of Natural Resource Conservation Service (NRCS) and available geologic information, the existing embankment materials were likely obtained from sources near the dam. New embankment materials used to raise and augment the existing embankment should be similar to existing embankment soils and should generally meet the criteria presented in the following table. It is likely that a suitable borrow source can be located in the area on or around the park.

TABLE 3.6: NEW EMBANKMENT MATERIAL RECOMMENDATIONS

Material	USCS Soil Classification	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Maximum Particle Size
New Embankment Soils	SC, CL, CH	20 to 60	10 to 20	10 to 40	30 and greater	3 inches

The existing dam embankment materials should be properly prepared prior to placing the new embankment materials. Vegetative materials should be removed prior to placing new fill against the face of the dam. To prevent the formation of a potential failure plane between the existing and new embankment materials, the existing embankment should be excavated and benched prior to placement of new embankment materials. The benches should extend approximately 18 inches into the existing embankment with approximately 6-inch vertical steps.

The horizontal portion of the benches should be scarified, moisture conditioned and compacted. New embankment materials should be moisture conditioned and placed in lifts with a maximum compacted thickness of 6-inches. Compaction and testing recommendations are presented in Table 3.7.

During construction activities, PSI recommends that the material placement be limited to 6 feet vertically per construction day to allow the excess pore water pressure resulting from fill placement to partially dissipate.

TABLE 3.7: COMPACTION AND TESTING RECOMMENDATIONS

Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Frequency
Existing Embankment Soils	ASTM D698	≥ 95%	0 to +4%	1 per 5,000 SF
New Embankment Soils	ASTM D698	≥ 95%	0 to +4%	1 per 5,000 SF; min. 3 per lift

3.10 **Surface Protection**

PSI recommends that the embankment crest and the downstream slope be protected from erosion by establishing a vegetative cover. Short-term stabilization, such as jute or synthetic mat may be required to aid in establishing erosion mitigation while the vegetation is in its initial growth stages.

3.11 **Embankment Settlement Analysis**

The increase in embankment height will create new stresses on both the existing dam embankment soils and the underlying foundation soils. The total settlements resulting from the placement of the

new embankment soils was estimated using *Settle3* version 5.0 from Rocscience, Inc. Based upon our analyses, the total additional settlement at the toe of the new dam embankment will be approximately ½ inch. The total additional settlement at the crest of the new dam embankment will be on the order of 2 inches. It is anticipated that portions of this settlement will occur during construction, and the remaining over a period of time after the construction process ends.

3.12 **Spillway Structure Foundation Analyses**

The sandstone exposed at bearing level may vary in degree of cementation and strength due to natural weathering and exposure to flowing water. To provide more uniform bearing conditions for the proposed structures, soft/loose materials identified at structure bearing levels should be further excavated until competent material is encountered. A representative of the Geotechnical Engineer should be present to observe the bearing material and confirm that they are suitable to support the proposed construction.

PSI recommends that a minimum of 12 inches of controlled low strength material (CLSM or Flowable Fill) be used beneath the spillway structure, retaining wall foundations, and crested weir foundations in areas where the subgrade conditions transition from the weakly cemented sandstone to soil (clay and sand). Where soft/loose materials are removed, the excavation should be filled with CLSM/Flowable Fill. The CLSM/Flowable Fill should be non-excavatable (minimum 200 psi) as specified by Item 401 Flowable Fill of the Texas Department of Transportation Standard Specifications.

The following table presents maximum allowable bearing capacities and coefficients of friction for the materials encountered in the test borings.

Table 3.8 – Maximum Allowable Bearing Capacity and Sliding Coefficient

Type of Bearing Materials	Maximum Allowable Bearing Capacity (psf)	Coefficient of Friction, Concrete to Soil
Sandy Clay (CL, CH)	1,000	0.35
Clayey Sand (SC)	1,000	0.4
Silty Sand (SM)	2,500	0.5
Sandstone	5,000	0.7

The Maximum Allowable Bearing Capacity values presented in the table have a factor of safety of approximately 3 with a total settlement of approximately 1 inch. Differential settlement over a 20-foot length should be on the order of ½ of the total settlement. The Coefficient of Friction values are **unfactored** (no factor of safety). **A factor of safety of 1.5 to 2.0 should be applied when calculating resisting forces against sliding.**

3.12.1 **Spillway Retaining Walls/Crested Weir**

Retaining walls will have a maximum design height of about 17 feet and the retaining wall footing will generally range from approximately 3 to 13 feet below the final adjacent ground surface. Walls should be designed to resist lateral earth pressures generated by the placed select fill materials.

To prevent short-circuit seepage, the backfill materials behind spillway retaining walls and the crested weir should consist of the excavated embankment soils or imported soils meeting the criteria presented in the following table.

TABLE 3.9: CLAYEY BACKFILL MATERIAL RECOMMENDATIONS

Location	USCS Soil Classification	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Maximum Particle Size
Spillway Retaining Walls/Crested Weir	CL, CH	20 to 60	10 to 20	10 to 40	50 and greater	3 inches

The clayey backfill materials should be placed behind the east and west spillway retaining walls from Station 2+80 through end of the upstream retaining walls at approximately Station 3+35. More granular materials can be placed behind the retaining walls extending from approximately Station 1+55 to Station 2+80.

The soils should be compacted to the density and moisture content presented in Table 3.11. The clayey soils will be compacted near optimum moisture content and above are not anticipated to exhibit significant expansive soil-related movements or apply swell pressures to the structures.

The use of active or at-rest earth pressures depends on the amount of horizontal movement that can occur along the wall height. The walls should be designed for active earth pressures if the top of the wall is not restrained, and the walls can deflect at the top. If the walls are restrained at the top, the at-rest earth pressure values should be used. The walls should be designed for additional lateral loads due to surcharge and live loads. Geogrids can be added to the backfill for the retaining walls to reduce the lateral loading on the wall.

Table 3.10 may be used to design soil retaining structures provided that the indicated retained/backfill materials occupy the entire active zone. The “active zone” consists of the area behind the retaining structure within a boundary created by a 45-degree angle drawn from the heel of the structure and extending upward to the ground surface. The equivalent fluid densities shown in the table do not include safety factors and apply to level backfill conditions. Sloped backfill conditions and other loads, such as equipment or foundations, will apply surcharge loads resulting in higher earth pressures.

An appropriate safety factor should be used in the design. The on-site fat clays are not recommended for backfill behind below-grade walls or retaining walls unless they are being placed in specific zone for seepage control.

Table 3.10: Lateral Earth Pressure Coefficients and Equivalent Fluid Densities

Type of Materials/Backfill Behind the Retaining System	Coefficient/Density Description	Active Condition	Passive Condition	At-Rest Condition
Sandy Clay (CL/CH)	Total Unit Weight (psf)		126	
	Effective Unit Weight (psf)		64	
	Angle of Internal Friction (degrees)		20	
	Coefficient	0.49	2.04	0.66
	Total Equivalent Fluid Density (psf/ft)	62	257	83
	Effective Equivalent Fluid Density (psf/ft)	31	130	42
Clayey Sands (SC)	Total Unit Weight (psf)		127	
	Effective Unit Weight (psf)		65	
	Angle of Internal Friction (degrees)		25	
	Coefficient	0.41	2.46	0.58
	Total Equivalent Fluid Density (psf/ft)	52	310	73
	Effective Equivalent Fluid Density (psf/ft)	26	156	37
Silty Sand (SM)	Total Unit Weight (psf)		128	
	Effective Unit Weight (psf)		66	
	Angle of Internal Friction (degrees)		33	
	Coefficient	0.30	3.39	0.46
	Total Equivalent Fluid Density (psf/ft)	38	434	59
	Effective Equivalent Fluid Density (psf/ft)	20	222	30
Sandstone	Total Unit Weight (psf)		140	
	Effective Unit Weight (psf)		78	
	Angle of Internal Friction (degrees)		42	
	Coefficient	0.20	5.05	0.33
	Total Equivalent Fluid Density (psf/ft)	28	707	46
	Effective Equivalent Fluid Density (psf/ft)	16	394	26
Granular Backfill with Less than 15% Fines	Total Unit Weight (psf)		136	
	Effective Unit Weight (psf)		74	
	Angle of Internal Friction (degrees)		40	
	Coefficient	0.22	4.60	0.36
	Total Equivalent Fluid Density (psf/ft)	30	621	49
	Effective Equivalent Fluid Density (psf/ft)	16	334	26

For structures located below the water level, effective unit weight and full hydrostatic pressures should be used to evaluate lateral earth pressures.

Drainage systems should be provided near, or at the base of the walls to collect and remove groundwater and prevent a buildup of hydrostatic pressure on the walls except where a wall penetrates a cut of zone in the dam. If provisions to prevent accumulations of water behind the walls are not provided, the walls should be designed to resist the full hydrostatic head in addition to the lateral earth pressures as outlined. In addition, prior to backfilling if a granular backfill is used, the excavated area should be lined with a geotextile filter-fabric designed to reduce the passage of fines. This will reduce the potential for fines migrating into the coarse backfill which could plug the drain system and create hydrostatic forces on the wall and saturate the footing bearing soils.

3.12.2 Compaction Recommendations for Spillway, Retaining Walls and Crested Weir

PSI anticipates that the spillway structure, retaining wall, and crested weir foundations will be supported on either weakly cemented sandstone or CLSM/Flowable Fill. These materials do not

require moisture conditioning and compaction. However, soils exposed at the base of excavations beneath retaining wall backfill and retaining wall backfill should be moisture conditioned and compacted as indicated in the table below.

Table 3.11: Compaction and Testing Recommendations

Material	Test Method for Density Determination	Percent Compaction	Optimum Moisture Content	Testing Frequency
Retaining Wall Backfill/Crested Weir	ASTM D698	≥ 95%	-1 to +3%	1 per 5,000 SF; min. 3 per lift
Base of Excavations beneath Wall Backfill	ASTM D698	≥ 95%	-1 to +3%	1 per 5,000 SF; min. 3 per lift

3.12.3 Spillway Soil/Rock Anchor Recommendations

PSI understands that the uplift forces acting on the bottom of the stilling basin will be resisted by the dead load of the stilling basin slab and 40 soil/rock anchors extending into the underlying weakly cemented sandstone. At this time, post-tensioned and passive anchors are being considered.

In post-tensioned anchor systems, load is transferred from the tensioning element, through a grout, to the surrounding soil/rock mass. A zone of compression is established within the zone of influence. The post-tensioned anchor system for being considered includes prestressed tendons.

Passive soil/rock anchors are an untensioned reinforcement elements consisting of a rod embedded in a grout-filled hole. Dowels provide positive resistance to dilation within the soil/rock mass. In addition to the development of tensile forces resisting dilation, passive resistance against sliding is developed within the soil/rock mass when lateral strains occur. The interaction between the dowel and the soil/rock mass is provided through the friction developed along the grout column, which bonds the rod and the soil/rock.

The design and analysis of anchor systems include determination of anchor loads, spacing, depth and bonding of the anchor. The anchor loads for post-tensioned anchors are determined from evaluation of safety factor requirements of structures. Anchors may be designed for stability considerations other than uplift to include sliding. Anchor depths depend on the type of soil/rock mass in which they are installed and the anchor pattern. The anchor depth is taken as the anchor length necessary to develop the anchor force required for stability. The entire anchor depth lies below the critical potential failure surface.

For a single row of anchors spaced “s” distance apart, the anchorage depth can be computed as follows:

$$D = \sqrt{\left[\frac{FS * F}{\gamma * s} \right]}$$

where D = required depth of anchor, feet

FS = desired factor of safety

F = anchorage force on each anchor, pounds

γ = unit weight of soil/rock, pounds per cubic foot

s = single row anchor spacing, feet

For the depth of anchors for a multiple row of anchors with rows spaced distance “l” apart, the depth of anchorage required to resist an anchorage force F per anchor is computed as follows:

$$D = \frac{(FS * F)}{(\gamma * I * s)}$$

where D = required depth of anchor

FS = desired factor of safety

F = anchorage force on each anchor

γ = unit weight of soil/rock, pounds per cubic foot

I = multiple rows of anchors spacing, feet

s = single row anchor spacing, feet

The equations presented above assume that the failure will occur within the soil/rock mass. The design of grouted anchorage must, therefore, ensure against failure between the anchor and the grout, as well as between the grout and the rock. Studies have shown that the bond developed between the grout and the anchor is typically twice that of the grout and the soil/rock. The anchor force that can be developed depends upon the bond stress as follows:

$$F = \pi * d * L * \tau$$

$$\tau = 0.5 * \tau_{ult}$$

where F = anchor force, pounds

d = effective diameter of the borehole, feet

L = length of the grouted portion of the anchor bond length (normally not less than 10-feet), feet

τ = working bond strength, pounds per square inch

τ_{ult} = ultimate bond strength at failure, pounds per square inch

For the soil/rock encountered beneath the spillway structure, the following table presents values for the ultimate bond stress between the soil/rock mass and the unit weight of the soil/rock:

Table 3.12: Soil/Rock Anchor Design Parameters

Material	Ultimate Bond Stress Between Soil/Rock	Soil Unit Weight, γ
Dense Sand	30 psi	125 pcf
Intact Weathered Sandstone	100 psi	140 pcf

3.13 Spillway Excavation Recommendations

Excavation for the new spillway and associated structures will extend into the existing embankment fill of the dam. Based upon review of the Buescher State Park Dam Repair construction drawings dated February 1993, the excavation for the new spillway will likely be within the repair zone of the embankment. Based upon the drawings the upstream portion of the dam was reconstructed using imported soils with a Unified Classification of CL. The downstream portion of the dam was reconstructed using the soils excavated from embankment.

The sandy clays encountered in the test borings and those within the reconstructed upstream portion of the existing embankment should be sloped at a slope angle of 1 Horizontal to 1 Vertical or flatter. The silty and clayey sands should be slope at a slope angle of 1 ½ Horizontal to 1 Vertical or flatter. Comparatively shallow excavations in sandstone (less than 10 feet) will likely stand near vertical (¾

Horizontal to 1 Vertical) for a short period time before exhibiting sloughing depending upon the degree of cementation.

Excavation for the west spillway retaining wall may extend into the puddled clay core within the existing embankment. Cut slopes into the clay core should be sloped at a slope angle of least 1 Horizontal to 1 Vertical or flatter. It may be necessary to construct flatter slopes (e.g., 2 Horizontal to 1 Vertical) depending upon the condition of the materials encountered.

If water or wet conditions are encountered in the excavations, it will be necessary to flatten the slopes and dewater the excavations. PSI understands that the pool level in the lake will be lowered to approximately 340 to 345 feet and that a cofferdam will be constructed to help control groundwater in the spillway area. The impact of these measures should be evaluated after they are implemented to properly assess groundwater conditions and the impact on spillway construction.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and Federal safety regulations.

Excavation equipment capabilities and field conditions may vary. Geologic processes are erratic and large variations can occur in small vertical and/or lateral distances. **The weakly cement sandstone is hard. Excavations penetrating in the sandstone and removal of these materials will likely require high-powered, heavy-duty rock excavation equipment.** Details regarding "means and methods" to accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor. The comments contained in this report are based on small diameter borehole observations.

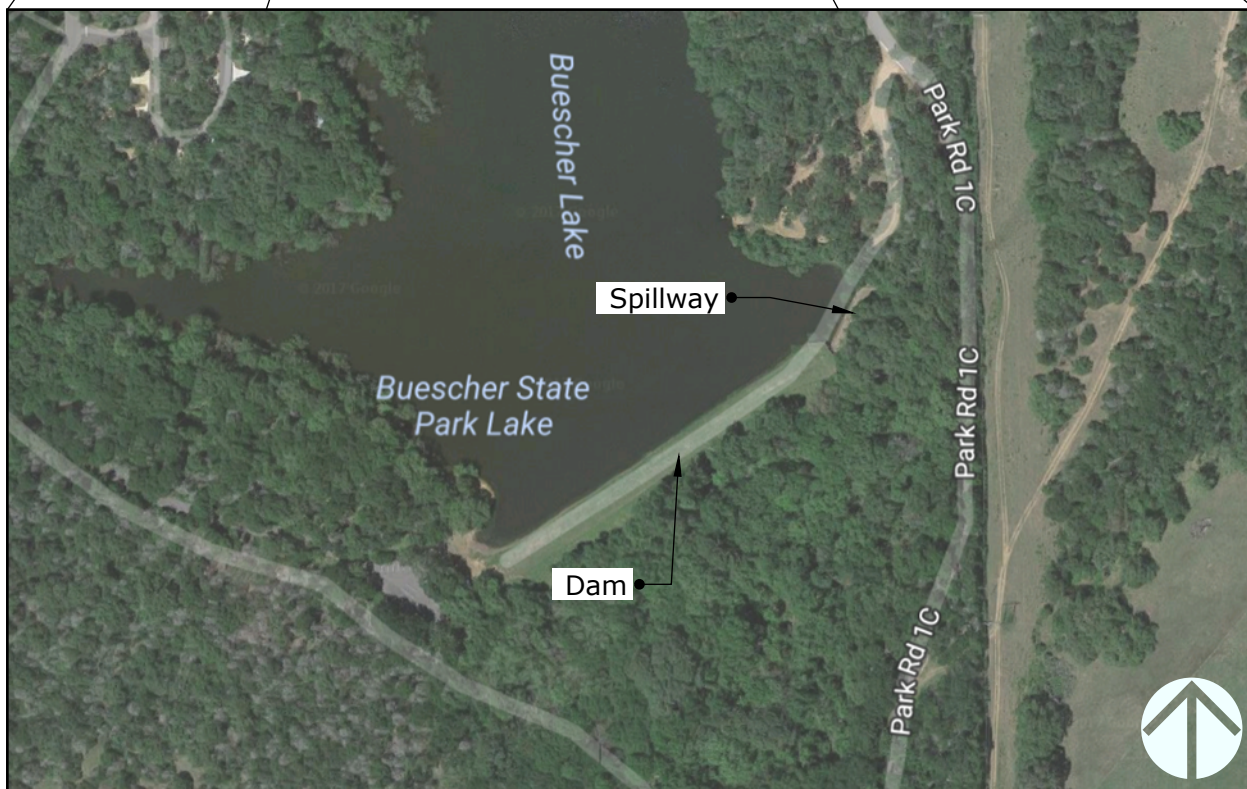
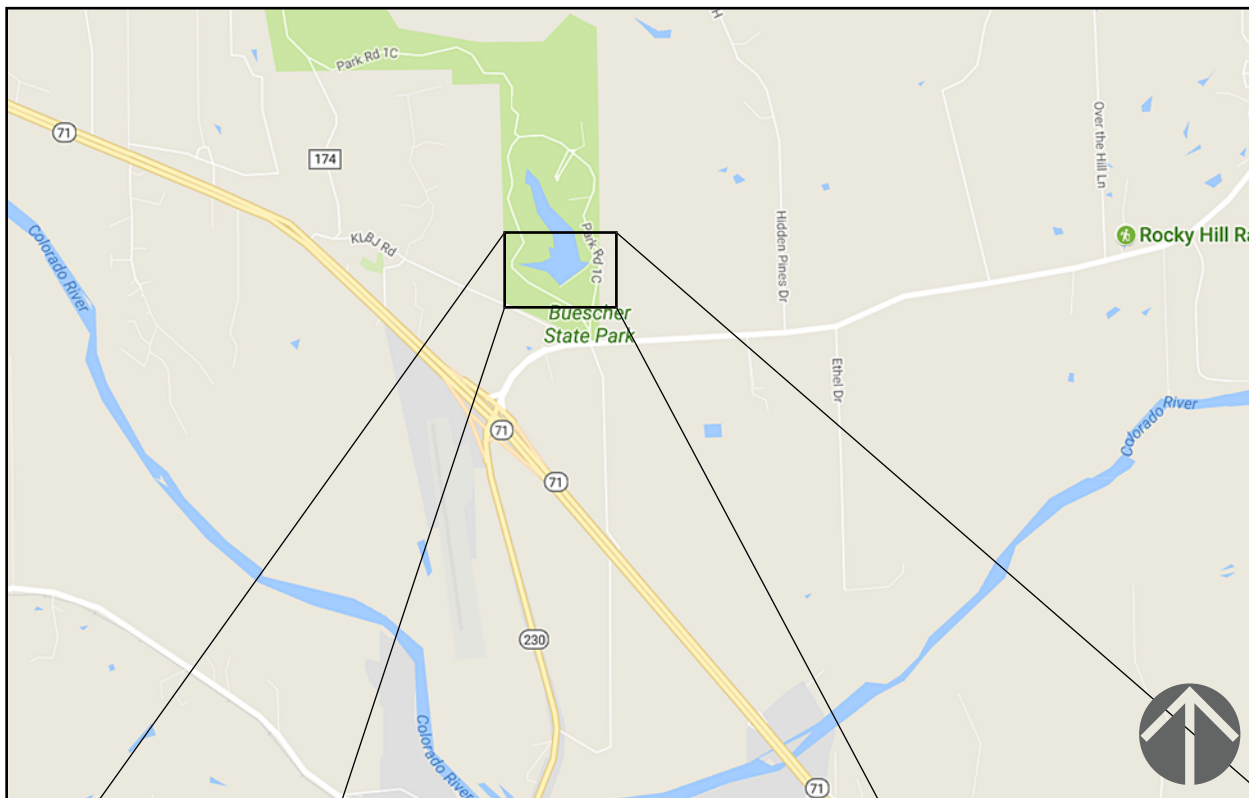
4.0 REPORT LIMITATIONS

The conceptual design recommendations submitted in this report are based on the available subsurface information obtained by PSI and design details furnished by the client for the proposed project. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes to the Dam design are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional Geotechnical Engineering practices in the local area. No other warranties are implied or expressed. This report may not be copied without the expressed written permission of PSI.

The recommendations of this Phase I 50% Design Geotechnical Report have been provided to assist Texas Parks and Wildlife Department (TPWD), Halff Associates, Inc. (Halff) and their Design Team to develop the preliminary dam replacement design and aid with budget estimation. Once a design for the preliminary design has been reviewed and finalized, PSI will perform additional engineering and testing in the Final Geotechnical Report that will include the final design.

APPENDIX A



**Dam Emankment & Spillway
Improvements** Buescher
State Park, Smithville, Texas

SITE VICINITY PLAN

Date
January 2020

PSI Project Number
0312-1939

Professional Service Industries, Inc.



3 Burwood Lane, San Antonio, Texas
(210) 342-9377 FAX (210) 342-9401

Boring Location Map

Proposed Buescher Dam Embankment & Spillway
Improvements, Buescher State Park
Smithville, Texas
PSI Project No.: 0312-1939

NOT TO SCALE



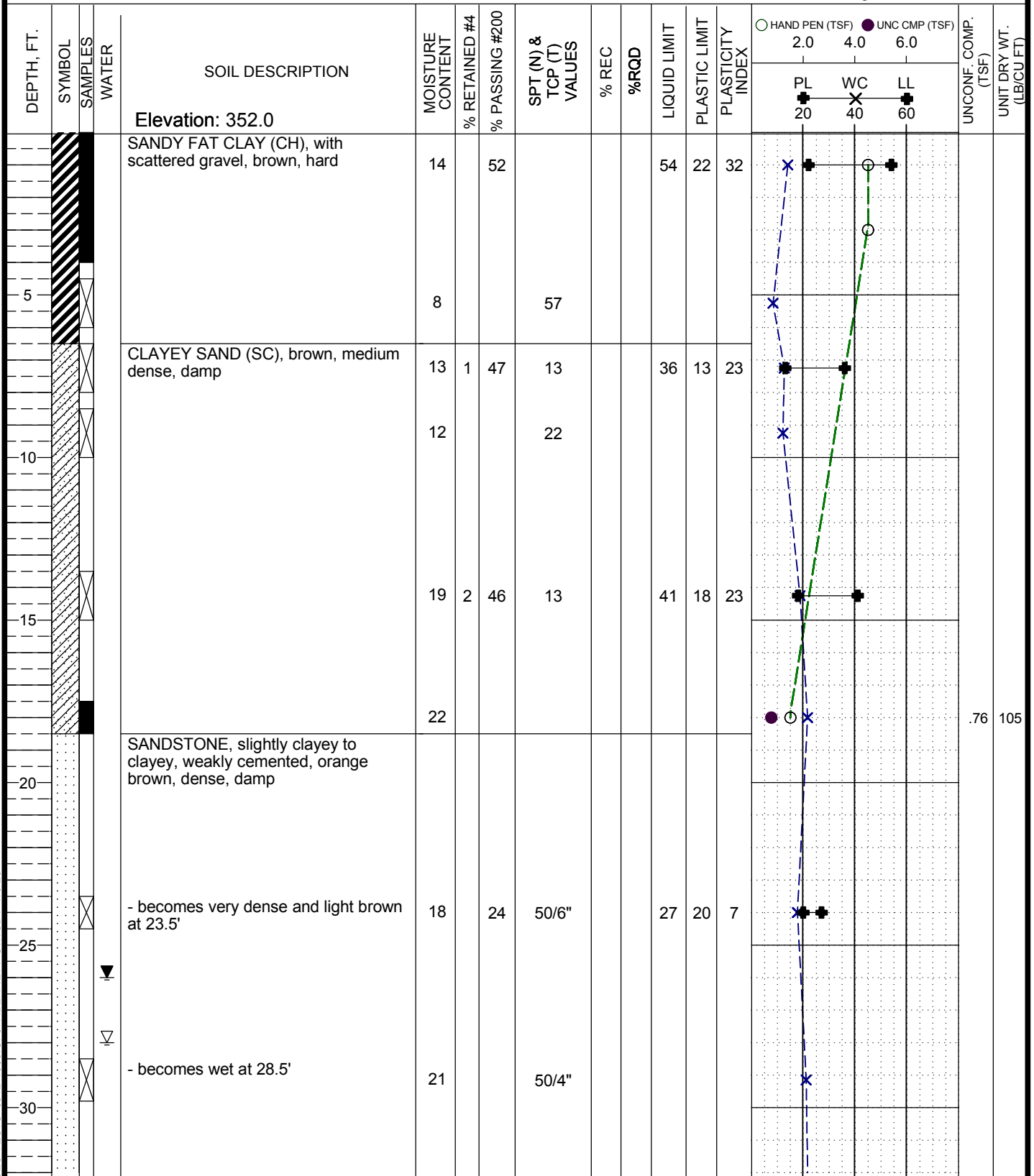
Buescher Lake Dam Embankment and Spillway Improvements

100 Park Road 1-C, Smithville, Texas

Project No. 0312-1939

BORING B1

LOCATION: See Boring Location Plan



COMPLETION DEPTH: 50.0 Feet

DATE: 11/18/19-11/18/19



DEPTH TO GROUND WATER

SEEPAGE (ft.): 28

END OF DRILLING (ft.): 26

DELAYED WATER LEVEL (FT):

GEO TESTS 0312-1939.GPJ RBENNETT GW.GDT 7/9/20

Buescher Lake Dam Embankment and Spillway Improvements

100 Park Road 1-C, Smithville, Texas

Project No. 0312-1939

BORING B1

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	<div> <div>○ HAND PEN (TSF)</div> <div>● UNC CMP (TSF)</div> </div> <div> <div>2.0</div> <div>4.0</div> <div>6.0</div> </div> <div> <div>PL</div> <div>WC</div> <div>LL</div> </div> <div> <div>20</div> <div>40</div> <div>60</div> </div>	UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
35		×		SANDSTONE, slightly clayey to clayey, weakly cemented, orange brown, very dense, damp - with 2" clay seam at 33.5'	22	3	22	50/6"			50	22	28	<div> <div>●</div> <div>●</div> </div>		
40		×		- with clay seams at 38.5'	24			50/5"						<div> <div>×</div> </div>		
45		×		- orange brown and grey at 43.5'	23			50/4"						<div> <div>×</div> </div>		
50		×			24		16	50/6"						<div> <div>×</div> </div>		
55				Boring terminated at about 50 feet.												
60																

COMPLETION DEPTH: 50.0 Feet

DATE: 11/18/19-11/18/19



DEPTH TO GROUND WATER

SEEPAGE (ft.): 28

END OF DRILLING (ft.): 26

Buescher Lake Dam Embankment and Spillway Improvements

100 Park Road 1-C, Smithville, Texas

Project No. 0312-1939

BORING B2

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	<div> <div>○ HAND PEN (TSF)</div> <div>● UNC CMP (TSF)</div> </div> <div> <div>2.0</div> <div>4.0</div> <div>6.0</div> </div> <div> <div>PL</div> <div>WC</div> <div>LL</div> </div> <div> <div>20</div> <div>40</div> <div>60</div> </div>	UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
				Elevation: 350.0												
				CLAYEY SAND (SC), brown, medium dense, damp	16	1	39				54	17	37	○		
					12									○		
5				- less clayey, more silty and orange brown at 4.5'	6		23	23			37	15	22	○		
					15			25						○		
				- with scattered gravel at 8.5'	16	9	46	23			22	19	3	○		
10																
				SANDY FAT TO LEAN CLAY (CH-CL), light brown to dark brown, stiff to very stiff, moist	17			14						○		
15																
					23	1	58	17			43	14	29	○		
20																
				CLAYEY SAND (SC), light brown, medium dense, wet	21			18						○		
25																
					22		44	12			71	26	45	○		
30																

COMPLETION DEPTH: 50.0 Feet

DATE: 11/18/19-11/18/19



DEPTH TO GROUND WATER

SEEPAGE (ft.): 23

END OF DRILLING (ft.): 23

DELAYED WATER LEVEL (FT):

GEO TESTS 0312-1939.GPJ RBENNETT GW.GDT 7/9/20

Buescher Lake Dam Embankment and Spillway Improvements

100 Park Road 1-C, Smithville, Texas

Project No. 0312-1939

BORING B2

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	<div> <div>○ HAND PEN (TSF)</div> <div>● UNC CMP (TSF)</div> </div> <div> <div>2.0</div> <div>4.0</div> <div>6.0</div> </div>			UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
														<div>PL</div> <div>20</div>	<div>WC</div> <div>40</div>	<div>LL</div> <div>60</div>		
35				CLAYEY SAND (SC), light brown, medium dense, wet	24			13										
40				- becomes dense with scattered gravel at about 38'	21	2	37	31			69	27	41					
45					17			35										
50				SANDSTONE, light brown, clayey, weakly cemented, very dense, wet	25	10	36	50/3"			43	17	26					
				Boring terminated at about 50 feet.														

COMPLETION DEPTH: 50.0 Feet

DATE: 11/18/19-11/18/19



DEPTH TO GROUND WATER

SEEPAGE (ft.): 23

END OF DRILLING (ft.): 23

GEO TESTS 0312-1939.GPJ RBENNETT GW.GDT 7/9/20

Buescher Lake Dam Embankment and Spillway Improvements

100 Park Road 1-C, Smithville, Texas

Project No. 0312-1939

BORING B3

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	% RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	<div> <div>○ HAND PEN (TSF)</div> <div>● UNC CMP (TSF)</div> </div> <div> <div>2.0</div> <div>4.0</div> <div>6.0</div> </div>			UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
														PL	WC	LL		
				Elevation: 340.0										20	40	60		
				CLAYEY SAND (SC), dark brown, medium dense, damp	21	3	39				47	25	22					
				SANDY LEAN CLAY (CL) with scattered gravel, light grey brown, very stiff to hard, damp	9													
5					14			33										
				SANDY FAT CLAY (CH) and SANDY LEAN CLAY (CL), dark orange brown, very stiff to hard, damp	16	2	60	37			45	19	26					
10					12			28										
				- with scattered gravel at about 13.5'	15	11	51	13			55	20	35					
15																		
				SILTY SAND (SM) with sandy clay seams, light brown, medium dense to dense, damp	13			19										
20																		
				- with clay seam at about 23.5'	13	2	37	19			29	19	10					
25																		
				- becomes wet at about 28'	24			36										
30				Boring terminated at about 30 feet.														

COMPLETION DEPTH: 30.0 Feet

DATE: 11/19/19-11/19/19



DEPTH TO GROUND WATER

SEEPAGE (ft.): 28

END OF DRILLING (ft.): 28

DELAYED WATER LEVEL (FT):

GEO TESTS 0312-1939.GPJ RBENNETT GW.GDT 7/9/20

Buescher Lake Dam Embankment and Spillway Improvements

100 Park Road 1-C, Smithville, Texas

Project No. 0312-1939

BORING B4

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL	SAMPLES	WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	TSF			UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT.)
														HAND PEN (TSF) UNC CMP (TSF)				
														2.0	4.0	6.0		
				Elevation: 342.0										PL	WC	LL		
				CLAYEY SAND (SC), orange brown, loose, moist	18		47							20	40	60		
					25													
				SANDSTONE, grey, weakly cemented, slightly clayey to clayey, very dense, damp	10		19	50/6"										
5																		
				- alternating grey and orange at 6.5'	12			50/5"										
					21			50/6"										
10																		
				- light brown and more silty at 13.5'	17		18	50/5"										
15																		
				- becomes wet at 18'	24			76										
20																		
					22			85										
25																		
					25		32	50/4"										
30																		
				Boring terminated at about 30 feet.														

COMPLETION DEPTH: 30.0 Feet

DATE: 11/18/19-11/18/19



DEPTH TO GROUND WATER

SEEPAGE (ft.): 18


























END OF DRILLING (ft.): 17

DELAYED WATER LEVEL (FT):

GEO TESTS 0312-1939.GPJ RBENNETT GW.GDT 7/9/20

Symbol Key Sheet

Material Symbols

	"FILL"		Clay (CH)		Sandy Clay (CL)		Silty Clay (CL)		Lean Clay (CL)
	Asphalt		Clayey Sand (SC)		Sand (SP)		Silty Sand (SM)		Gravelly Sand (SP)
	Base		Clayey Silt (ML)		Sandy Silt (ML)		Silt (ML)		Gravelly Silt (ML)
	Concrete		Clayey Gravel (GC)		Sandy Gravel (GP)		Silty Gravel (GM)		Gravel (GP or GW)
	Conglomerate		Limestone		Marl		Sandstone		Shale

Strength of Cohesive Soils

Consistency	Undrained Shear Strength, KSF
Very Soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

Soil Plasticity

Degree of Plasticity	Plasticity Index (PI)
None	0 to 5
Low	5 to 10
Moderate	10 to 20
Plastic	20 to 40
Highly Plastic	more than 40

Density of Granular Soils

Descriptive Term	SPT Blow Count (blows/ft)
Very Loose	less than 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	more than 50

Standard Penetration Test (ASTM D 1586) Driving Record

Note: Driving is limited to 50 blows per interval, or 25 blows for 0.25 inch advancement, whichever controls. This is done to avoid damaging sampling tools.

Blows Per Foot	Description
25	Sampler was seated 6 inches, then 25 blows were required to advance the sampler 12 inches.
75/8"	Sampler was seated 6 inches, 25 blows were required for the second 6 inch increment and the 50 blow limit was reached at 2 inches of the last increment.
Ref/2"	Sampler could only be driven 2 inches of the 6 inch seating penetration before the 50 blow limit was reached.








Terms Characterizing Structure

Soil Terms	Description
Blocky	Contains cracks or failure planes resulting in rough cubes of material.
Calcareous	Contains appreciable quantities of calcium carbonate.
Fissured	Contains shrinkage cracks, which are frequently filled with fine sand or silt. The fissures are usually near vertical in orientation.
Interbedded	Composed of alternating layers of different soil types.
Laminated	Composed of thin layers of varying color and texture.
Nodules	Secondary inclusions that appear as small lumps about 0.1 to 0.3 inch in diameter.
Partings	Inclusion of different material less than 1/8 inch thick extending through the sample.
Pockets	Inclusion of different material that is smaller than the diameter of the sample.
Seams	Inclusion of different material between 1/8 and 3 inches thick, and extends through the sample.
Slickensided	Has inclined planes of weakness that are slick and glossy in appearance. Slickensides are commonly thought to be randomly oriented.
Streaks or Stains	Stains of limited extent that appear as short stripes, spots or blotches.

Rock Terms

Bedding Plane	A surface parallel to the surface of deposition, generally marked by changes in color or grain size.
Fracture	A natural break in rock along which no displacement has occurred.
Joint	A natural break along which no displacement has occurred, and which generally intersects primary surfaces.
% Recovery	The ratio of total length of recovery to the total length of core run, expressed as a percentage.
RQD - Rock Quality Designation	The ratio of total recovered length of fragments longer than 4 inches to the total run length, expressed as a percentage.
Weathering	The process by which rock is broken down and decomposed.

Sampler Symbols

	Flight Auger		Core Barrel		Disturbed Shelby Tube (3")		No Recovery		Grab Sample		Undisturbed Shelby Tube (3")		SPT Sample
---	--------------	---	-------------	---	----------------------------	---	-------------	---	-------------	---	------------------------------	---	------------

Direct Shear of Soil Under Consolidated-Drained Conditions

Client: Intertek-PSI

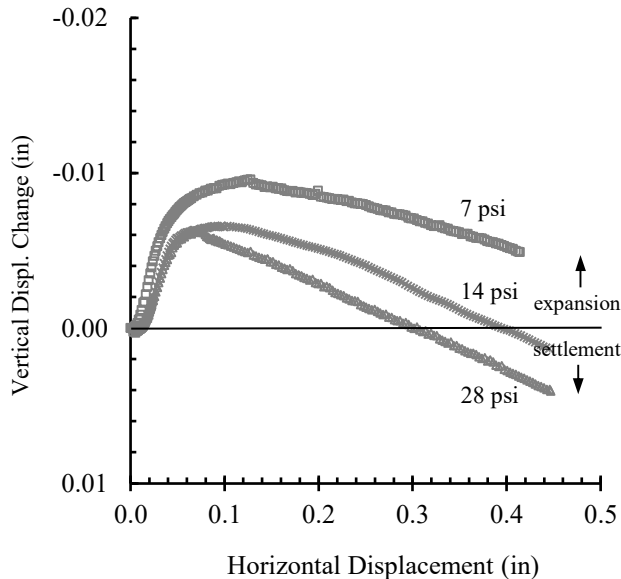
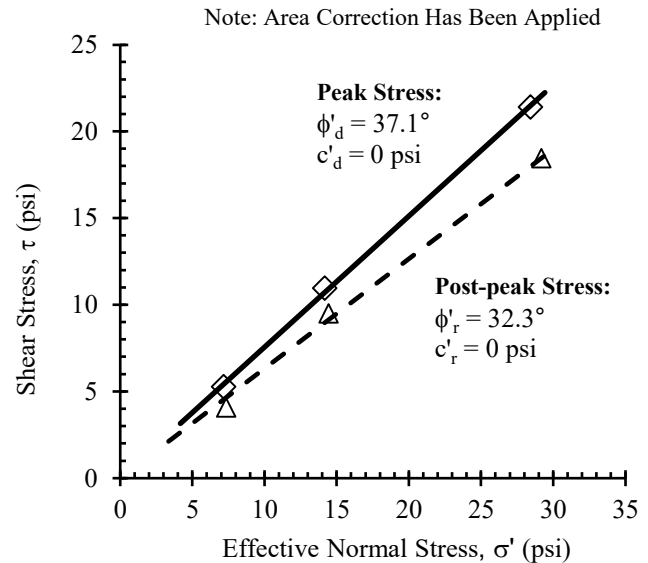
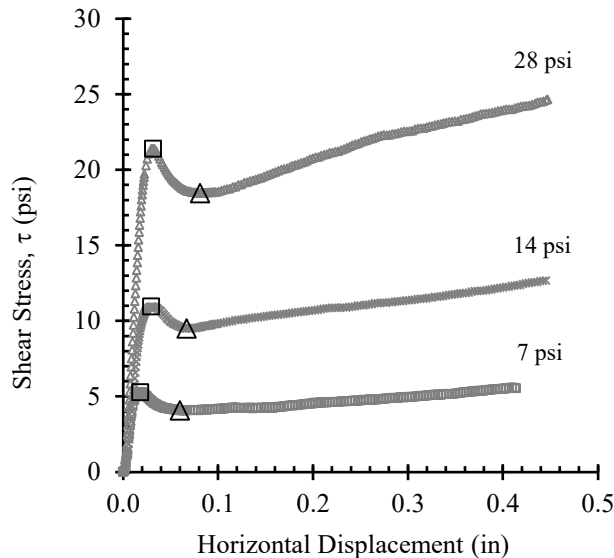
Project: Bucasher Spillway

Specimen: B-1 Composite (28.5-29.8', 33.5-34.5', 38.5-39.4',
& 43.5-44.3')

Beyond Project No.: LT1912148

Test Method: ASTM D3080

Test Date: 12/10/19



Sample Number		1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	9.1	9.4	9.5
	Saturation, %	47.9	49.0	49.5
	Dry Unit Weight, pcf	110.6	110.2	110.4
	Void Ratio	0.51	0.51	0.51
Post Consol	Height, in (prior to shear)	0.99	0.99	0.99
	Final Water Content, %	18.7	18.3	18.4
	Dry Unit Weight, pcf	111.1	111.1	111.2
	Void Ratio	0.50	0.50	0.50
Peak Normal Stress, σ' (psi)		7.2	14.2	28.4
Peak Shear Stress, τ (psi)		5.3	11.0	21.4
Displacement at Failure (in)		0.02	0.03	0.03
Displacement rate (in/min)		0.0005	0.0005	0.0005
Peak Strength Parameters		ϕ'_d , degrees	37.1	
		c'_d , psi	0	
Post-peak Strength Parameters		ϕ'_r , degrees	32.3	
		c'_r , psi	0	

Note: Specimens remolded to 110 pcf dry density at 10 % water content per request. The specific gravity of 2.67 was assumed.

Cheng-Wei Chen, Ph.D. 12/11/19

Analysis & Quality Review/Date

Specimens prepared by: T.D.

The results shown on this report are for the exclusive use of the client for whom they were obtained and apply only to the sample tested and / or inspected. They are not intended to be indicative of qualities of apparently identical products. The use of our name must receive prior written approval. Reports must be reproduced in their entirety. Unauthorized use or copying of this document is strictly prohibited by anyone other than the client for the specific project.

Direct Shear of Soil Appendix

Client: Intertek-PSI
Project: Buescher Spillway
Specimen: B-1 Composite (28.5-29.8', 33.5-34.5', 38.5-39.4',
& 43.5-44.3')

Beyond Project No.: LT1912148
Test Method: ASTM D3080
Test Date: 12/10/19



(a) Normal Load = 7 psi



(b) Normal Load = 14 psi



(c) Normal Load = 28 psi



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Direct Shear of Soil Under Consolidated-Drained Conditions

Client: Intertek-PSI

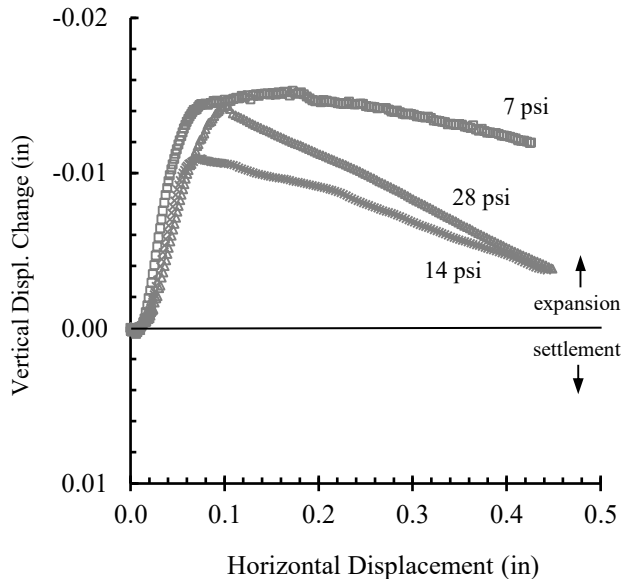
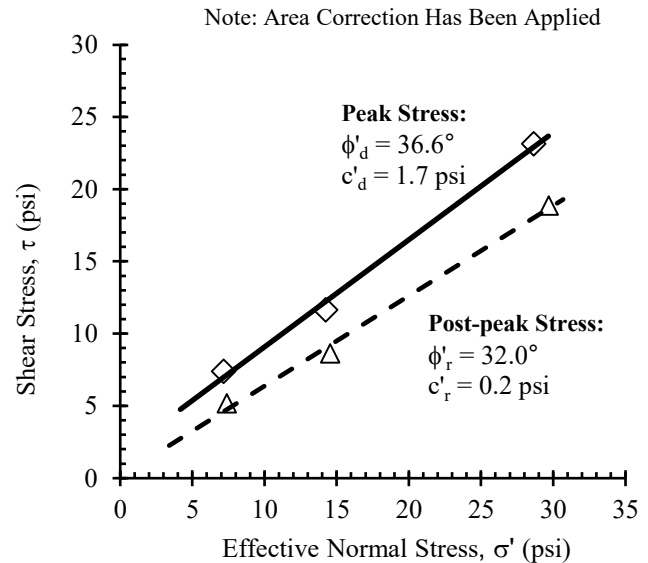
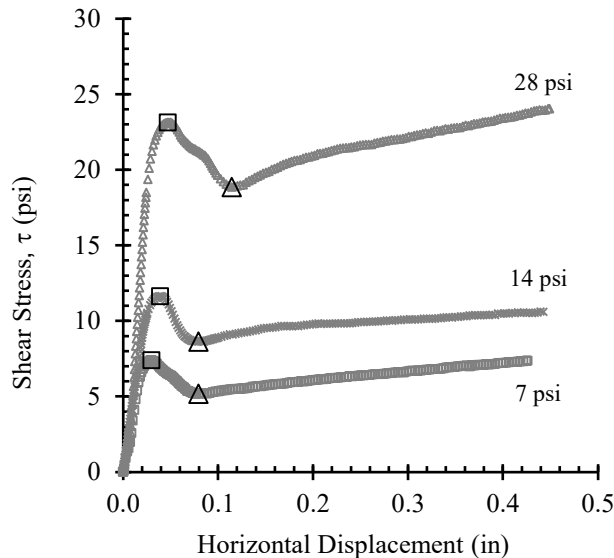
Project: Bucasher Spillway

Specimen: B-4 Composite (6.5-7.5', 8.5-9.5', 13.5', 18.5-20' & 23.5-25')

Beyond Project No.: LT1912148

Test Method: ASTM D3080

Test Date: 12/11/19



Sample Number		1	2	3
Initial Condition	Diameter, in	2.50	2.50	2.50
	Height, in (before consol)	1.00	1.00	1.00
	Water Content, %	9.9	9.8	9.9
	Saturation, %	51.1	50.8	51.0
	Dry Unit Weight, pcf	109.8	110.1	110.0
	Void Ratio	0.52	0.51	0.52
Post Consol	Height, in (prior to shear)	1.00	0.99	0.99
	Final Water Content, %	18.5	18.3	18.3
	Dry Unit Weight, pcf	110.1	110.7	111.3
	Void Ratio	0.51	0.51	0.50
Peak Normal Stress, σ' (psi)		7.2	14.2	28.6
Peak Shear Stress, τ (psi)		7.4	11.6	23.1
Displacement at Failure (in)		0.03	0.04	0.05
Displacement rate (in/min)		0.0005	0.0005	0.0005
Peak Strength Parameters		ϕ'_d , degrees	36.6	
		c'_d , psi	1.7	
Post-peak Strength Parameters		ϕ'_r , degrees	32.0	
		c'_r , psi	0.2	

Note: Specimens remolded to 110 pcf dry density at 10 % water content per request. The specific gravity of 2.67 was assumed.

Cheng-Wei Chen, Ph.D. 12/12/19

Analysis & Quality Review/Date

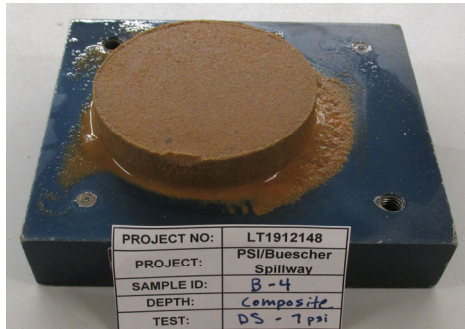
Specimens prepared by: T.D.

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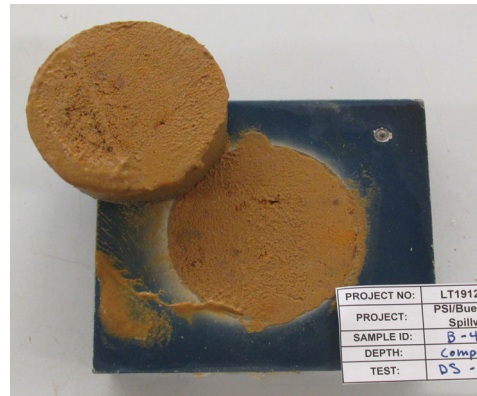
Direct Shear of Soil Appendix

Client: Intertek-PSI
Project: Buescher Spillway
Specimen: B-4 Composite (6.5-7.5', 8.5-9.5', 13.5', 18.5-20' & 23.5-25')

Beyond Project No.: LT1912148
Test Method: ASTM D3080
Test Date: 12/11/19



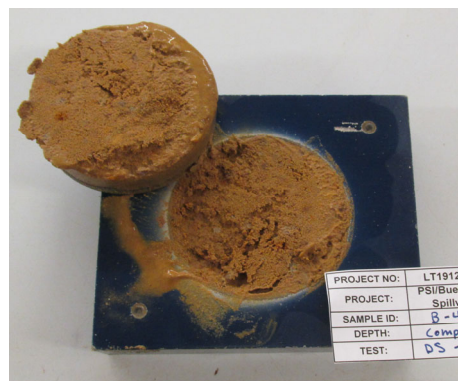
(a) Normal Load = 7 psi



(b) Normal Load = 14 psi

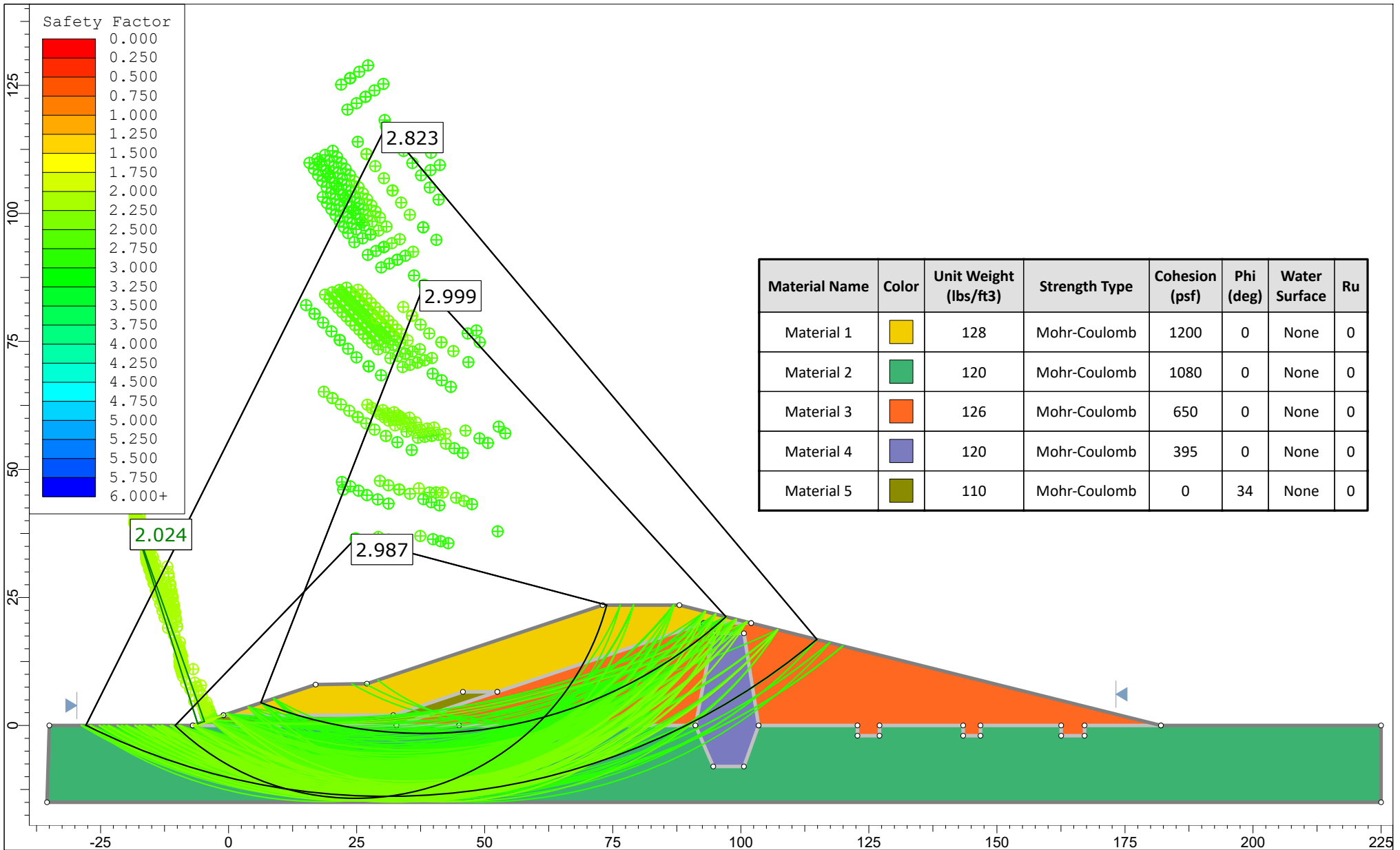


(c) Normal Load = 28 psi



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APPENDIX B



intertek
psi

Project

Buescher Dam Slope Stability

Analysis Description

Bishop Simplified - End of Construction Scenario

Drawn By

K. C. Miller and A. Wilkes

Scale

1:310

Company

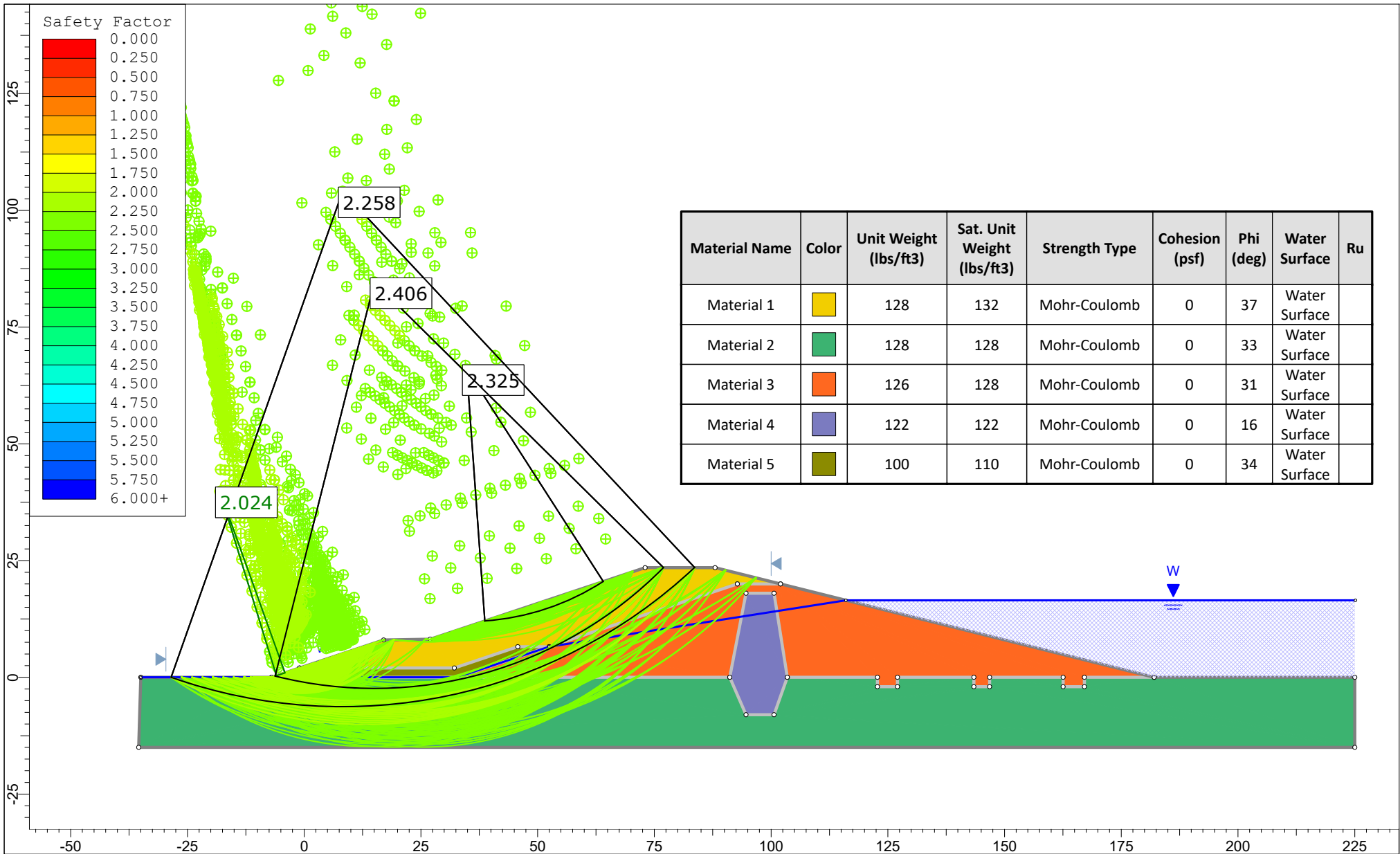
Intertek PSI

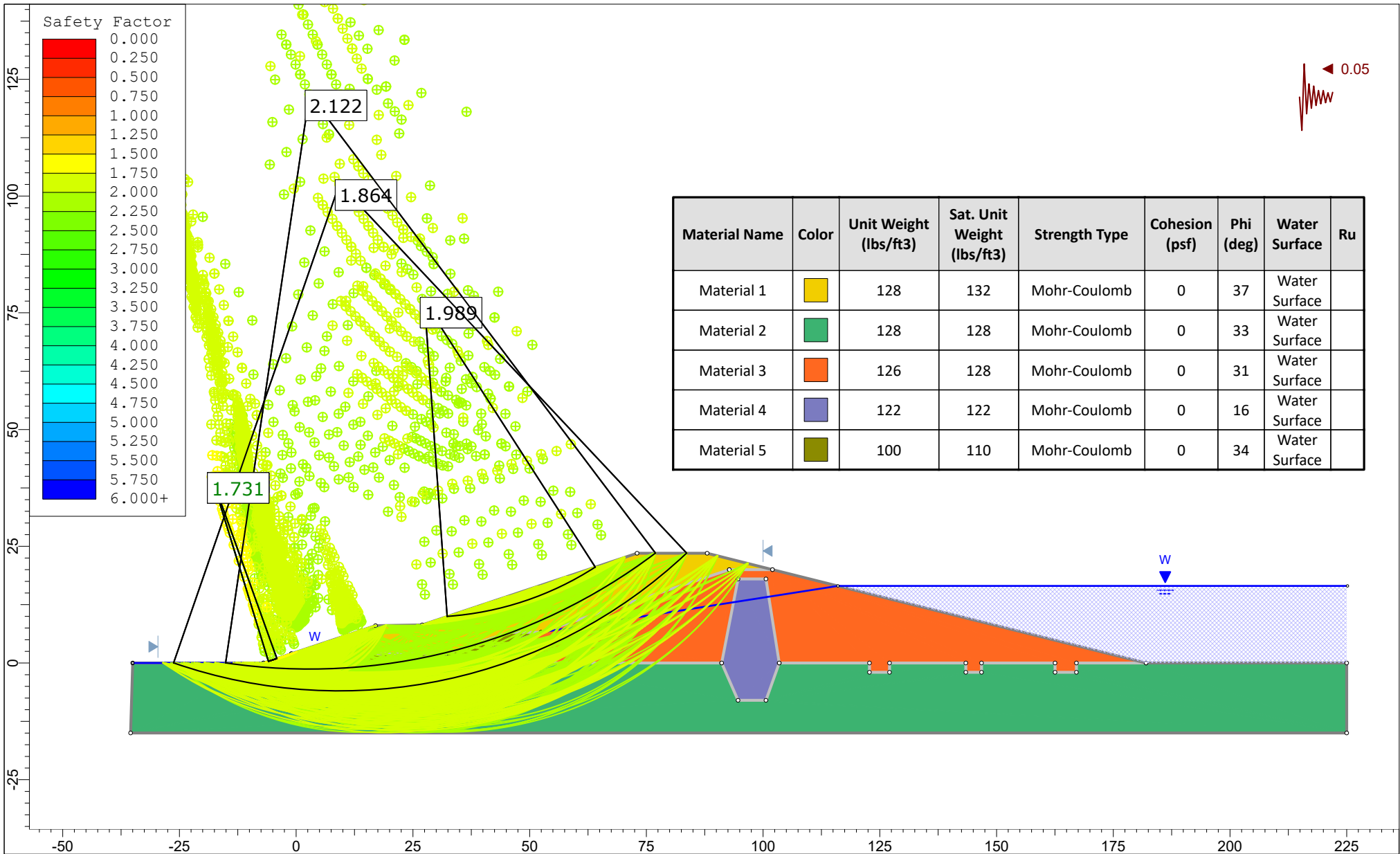
Date

18 December 2019

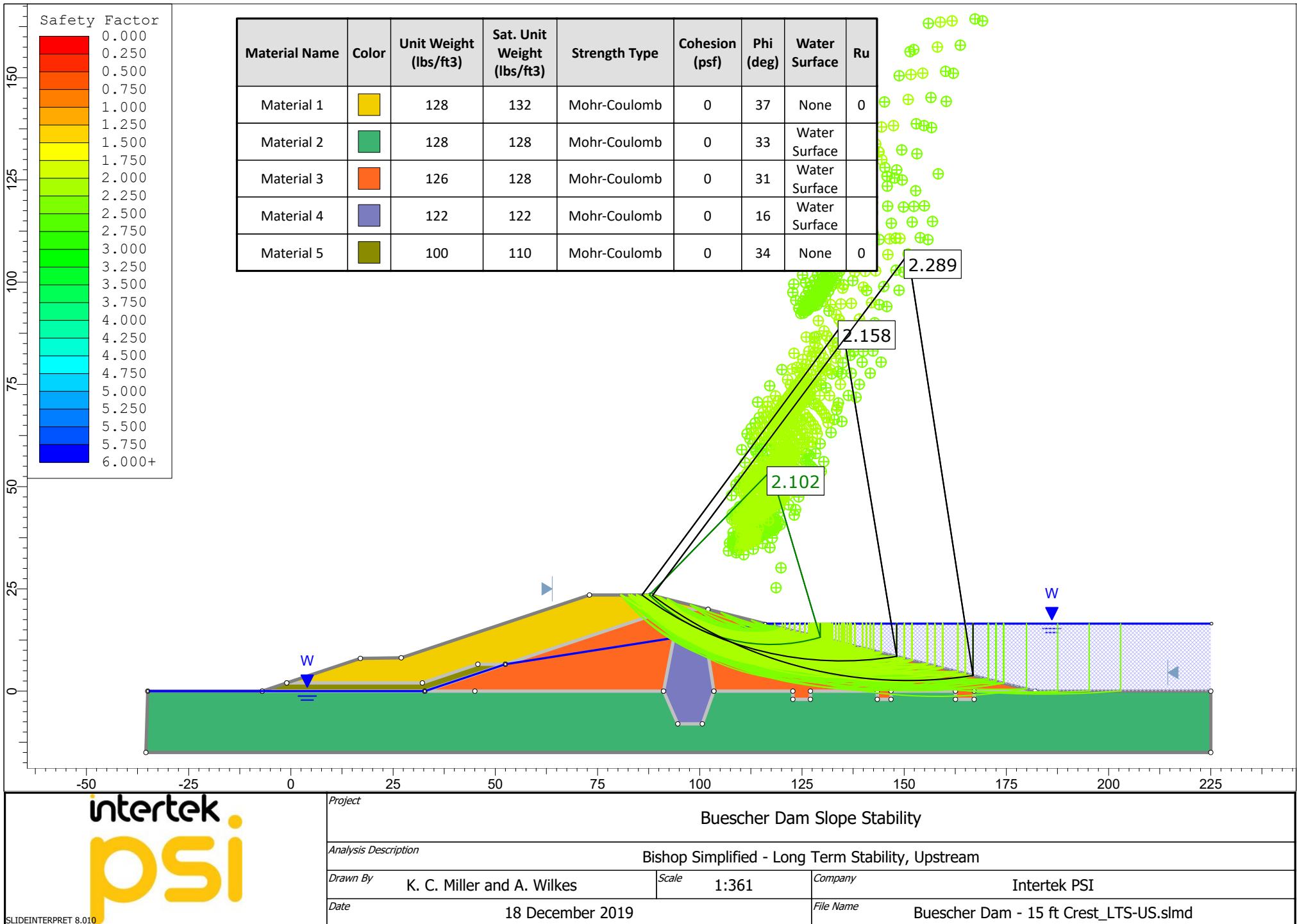
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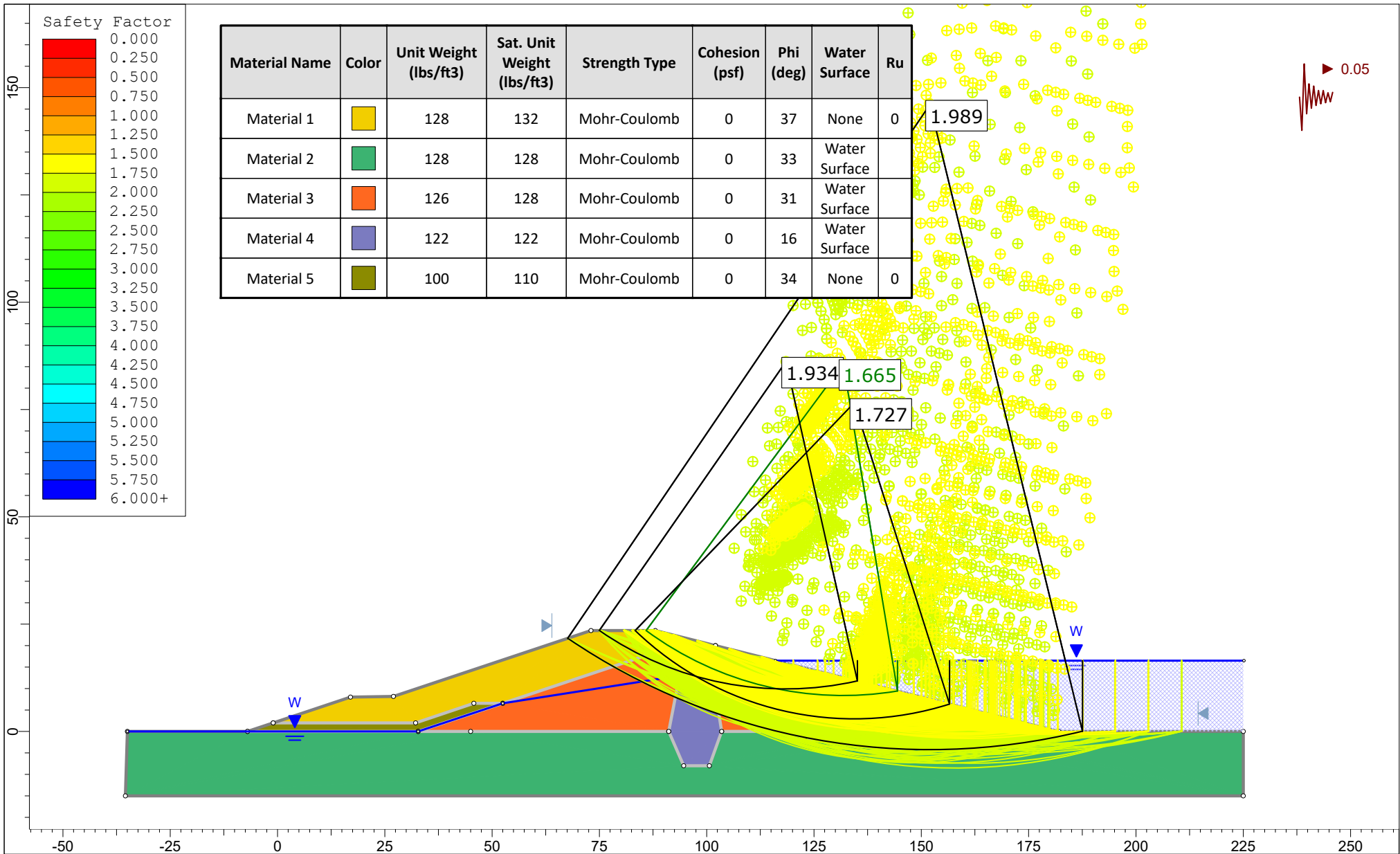
Buescher Dam - 15 ft Crest_EOC.slmd





	Project			Buescher Dam Slope Stability	
	Analysis Description			Bishop Simplified - Long Term Stability, Downstream	
	Drawn By	K. C. Miller and A. Wilkes	Scale	1:341	Company Intertek PSI
	Date	18 December 2019		File Name	Buescher Dam - 15 ft Crest_LTS-kcm1.slmd





Project

Buescher Dam Slope Stability

Analysis Description

Bishop Simplified - Long Term Stability, Upstream

Drawn By

K. C. Miller and A. Wilkes

Scale

1:372

Company

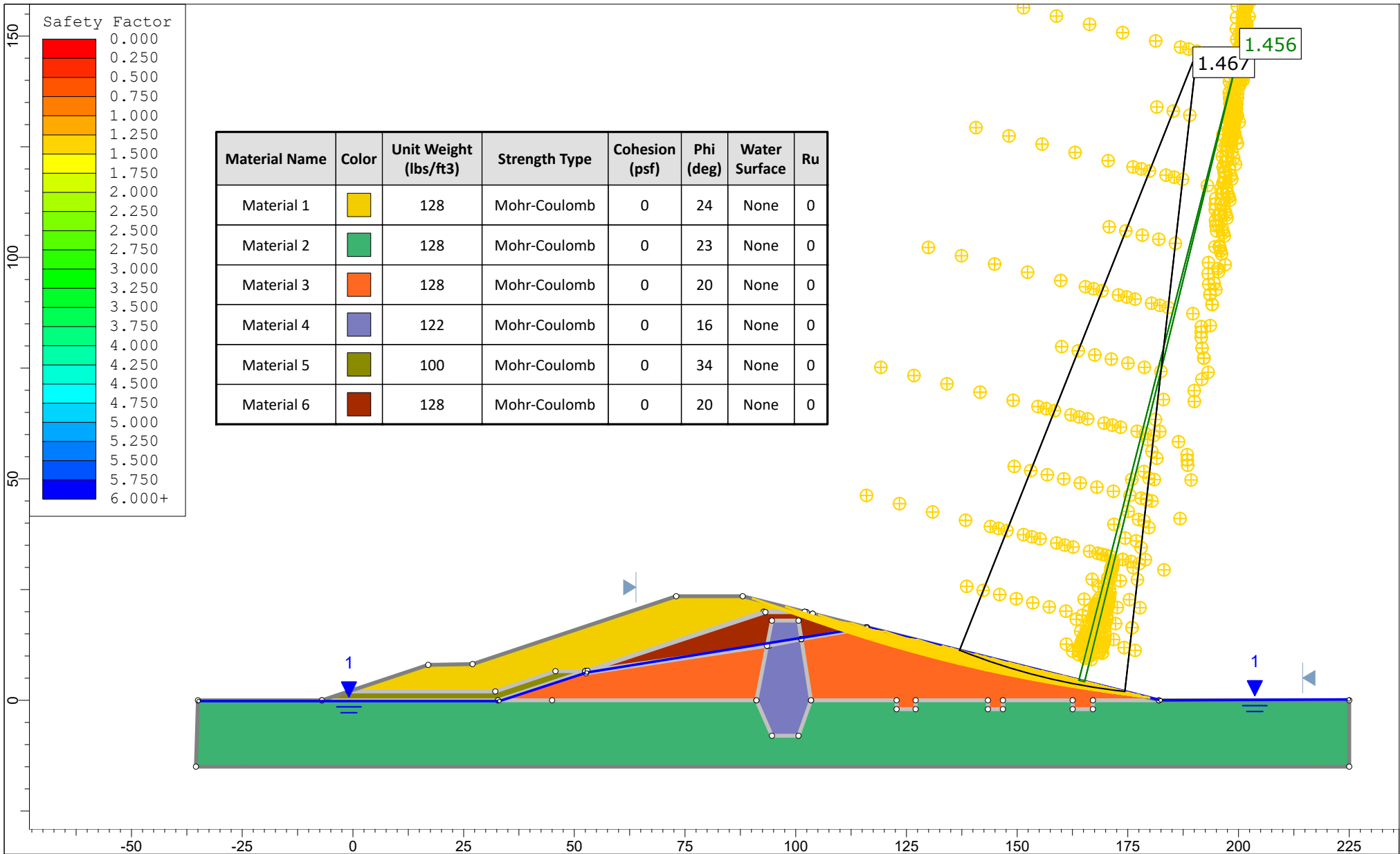
Intertek PSI

Date

18 December 2019

File Name

Buescher Dam - 15 ft Crest_LTS-US.slmd



Project

Buescher Dam Slope Stability

Analysis Description

Bishop Simplified - Rapid Drawdown, Upstream

Drawn By

K. C. Miller and A. Wilkes

Scale

1:360

Company

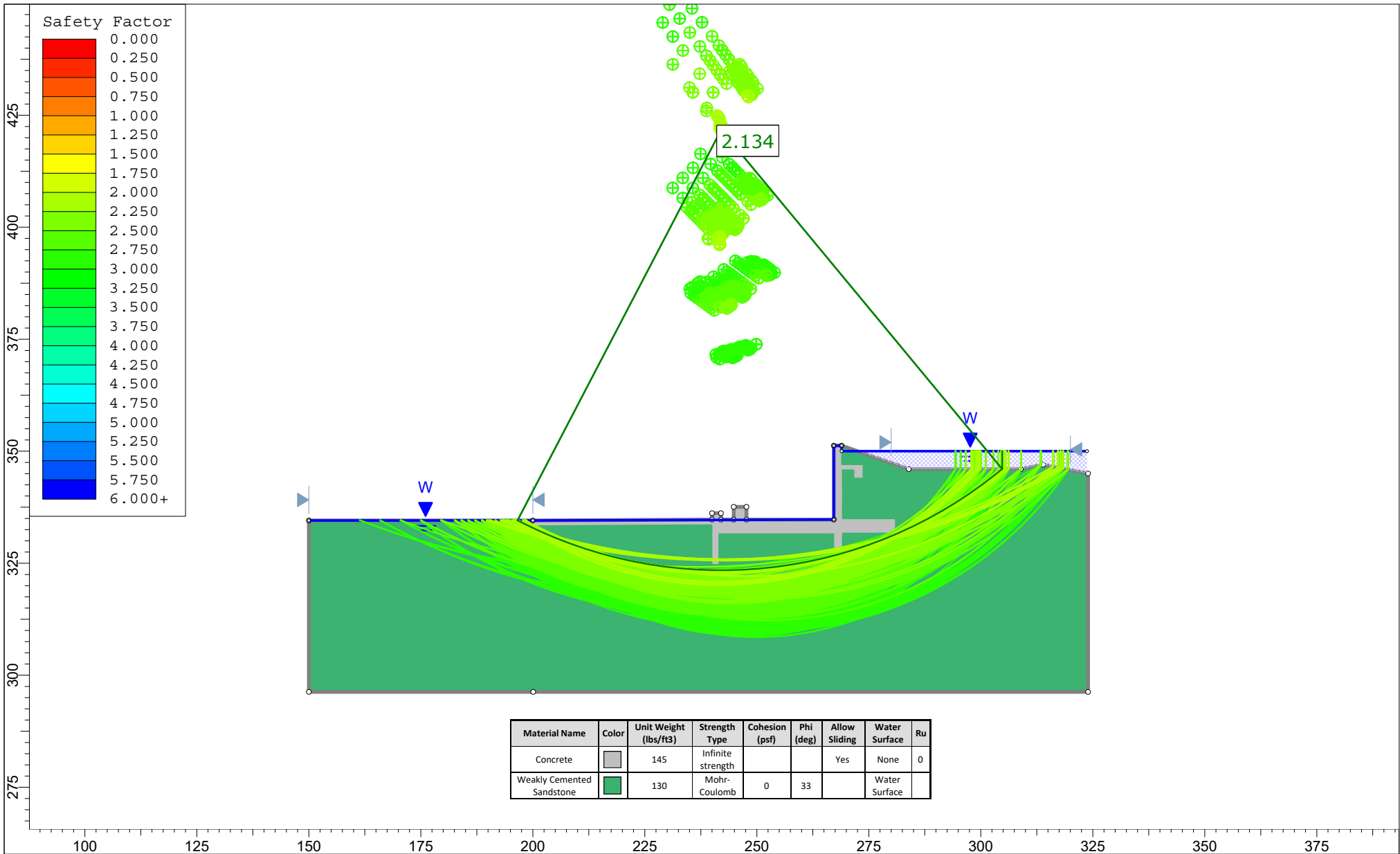
Intertek PSI


Date

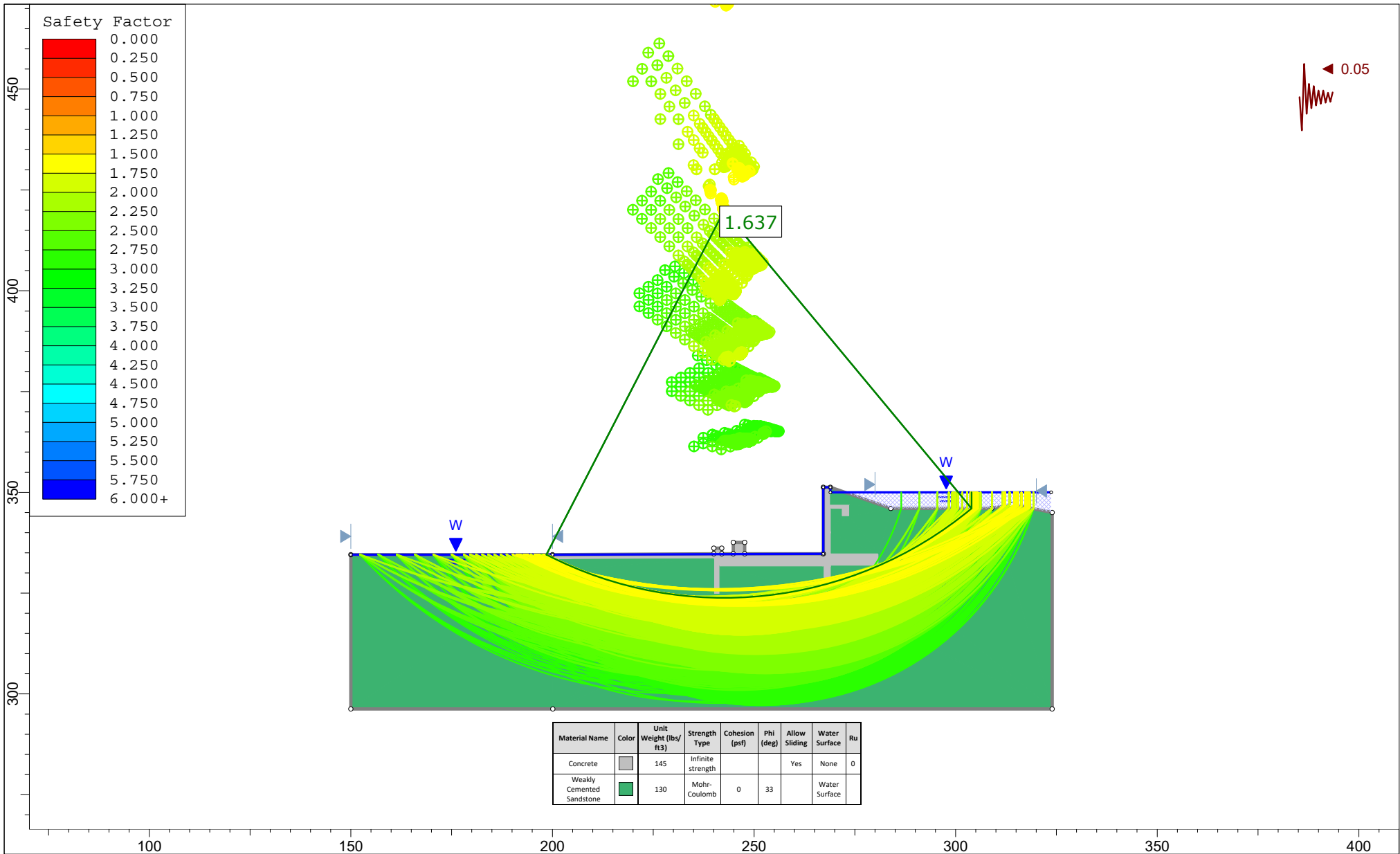
16 January 2020

File Name

Buescher Dam - 15 ft Crest_RDD-US.slmd



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	Analysis Description		Bishop Simplified - Spillway Stability Analysis	
	Drawn By		R. Webb	Company Intertek PSI
	Date		7/29/2020, 10:03:01 AM	File Name Spillway Sliding Analysis.slmd



Project

Buescher Dam Slope Stability

Analysis Description

Earthquake Bishop Simplified - Spillway Stability Analysis

Drawn By

R. Webb

Company

Intertek PSI

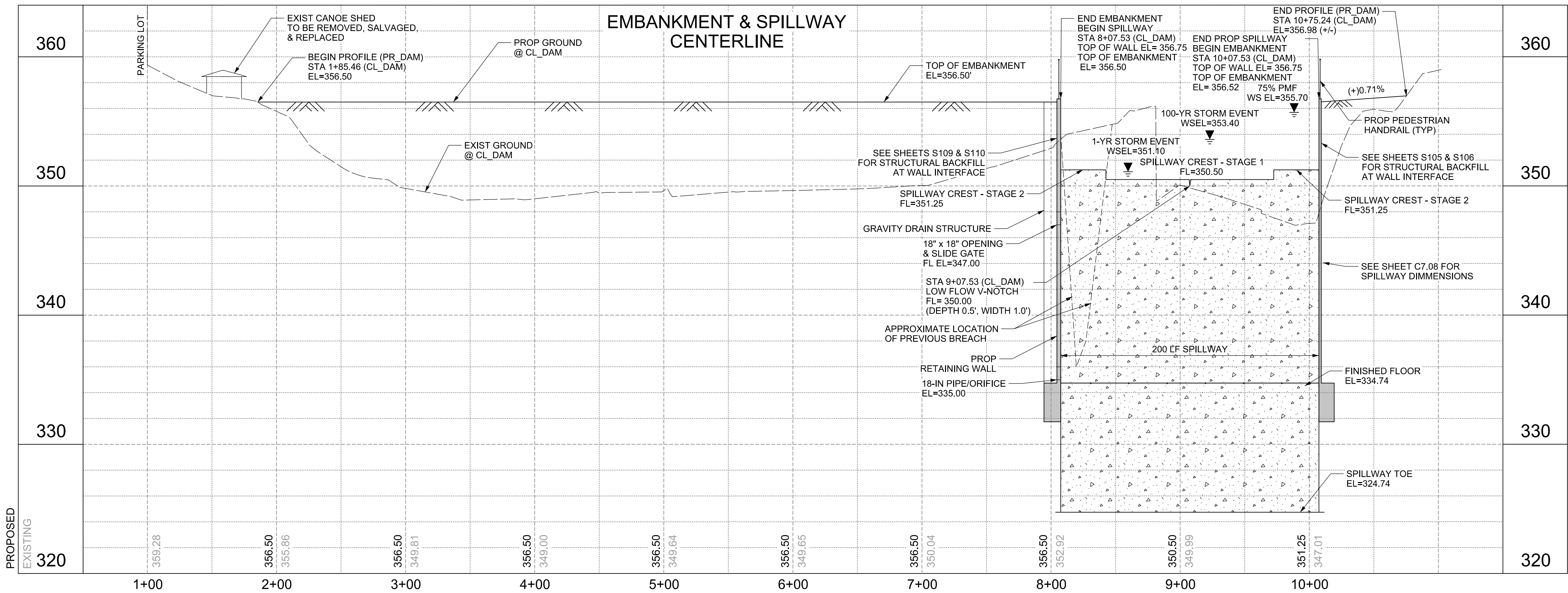
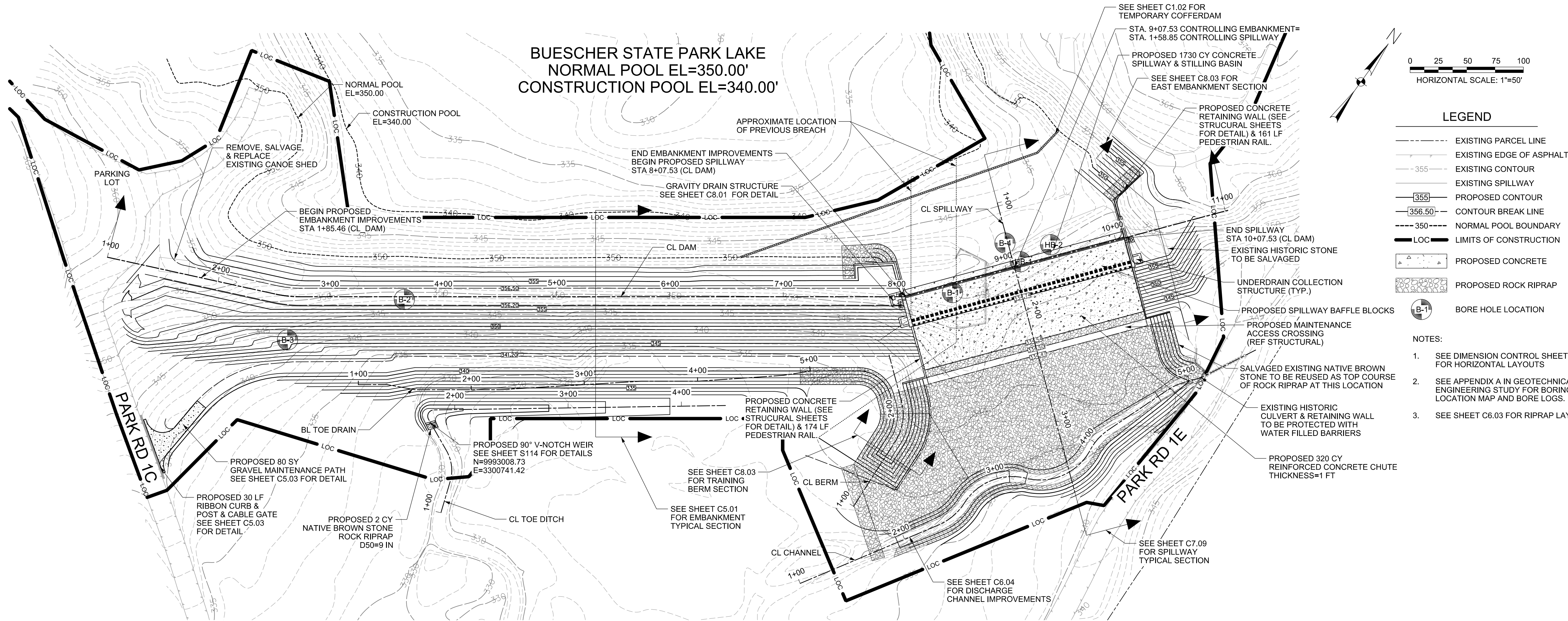
Date

7/29/2020, 10:03:01 AM

File Name

Spillway Sliding Analysis.slmd

APPENDIX C



TEXAS PARKS AND WILDLIFE
CIVIL ENGINEERING SERVICE
INFRASTRUCTURE AND PLANNING DESIGN

MAILING ADDRESS:
4200 SMITH SCHOOL ROAD
AUSTIN, TX 78744

TEL: (512) 389-4800 FAX: (512) 389-8628

TEXAS
PARKS &
WILDLIFE

HALFF

9500 AMBERGLEN BLVD.
SUITE 100
AUSTIN, TX 78750
TEL (512) 942-6232
FAX (512) 868-0089

TBPELS ENGINEERING FIRM #312

BUESCHER STATE PARK
LAKE DAM IMPROVEMENTS
TPWD# 118686

PRELIMINARY
FOR INTERIM REVIEW ONLY

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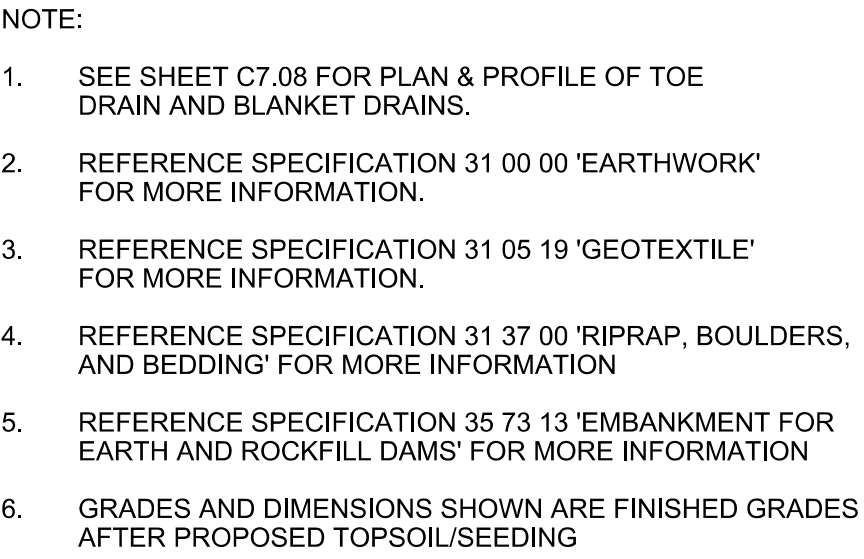
JEFFREY L. NAGY 133255
NAME P.E. NO.
DATE 12/2/2020
TBPELS ENGINEERING FIRM #312

Revision No.	Date	Description

PROJECT NUMBER: 118686
DATE: 12/2/2020

Sheet Title
DAM PLAN & PROFILE

Sheet Number
C5.02



HALFF
9500 AMBERGLEN BLVD.
BUILDING F SUITE 125
AUSTIN, TX 78729
TEL (512) 942-6232
FAX (512) 869-0089
TRBES S. ENGINEERING EIDM #312

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JEFFREY L NAGY	133255
NAME	P.E. NO.
DATE	12/2/2020

TBPELS ENGINEERING
FIRM #312

[illegible]

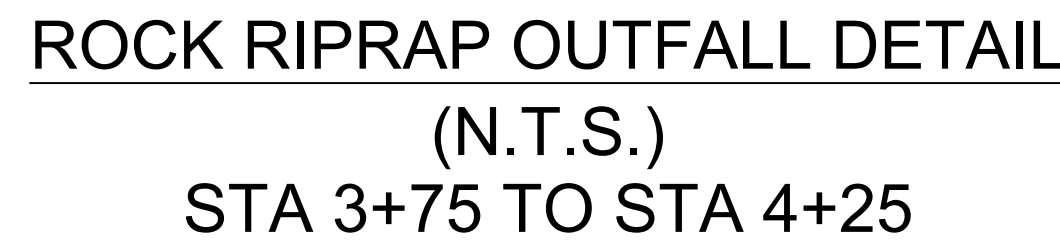
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DATE: 12/2/202

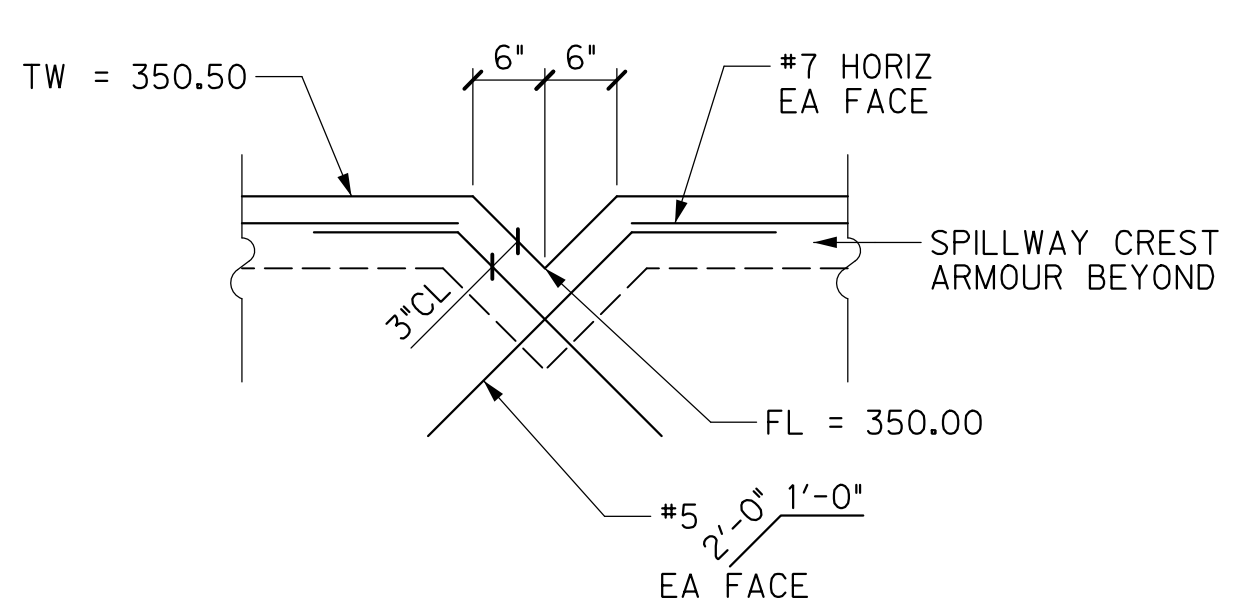
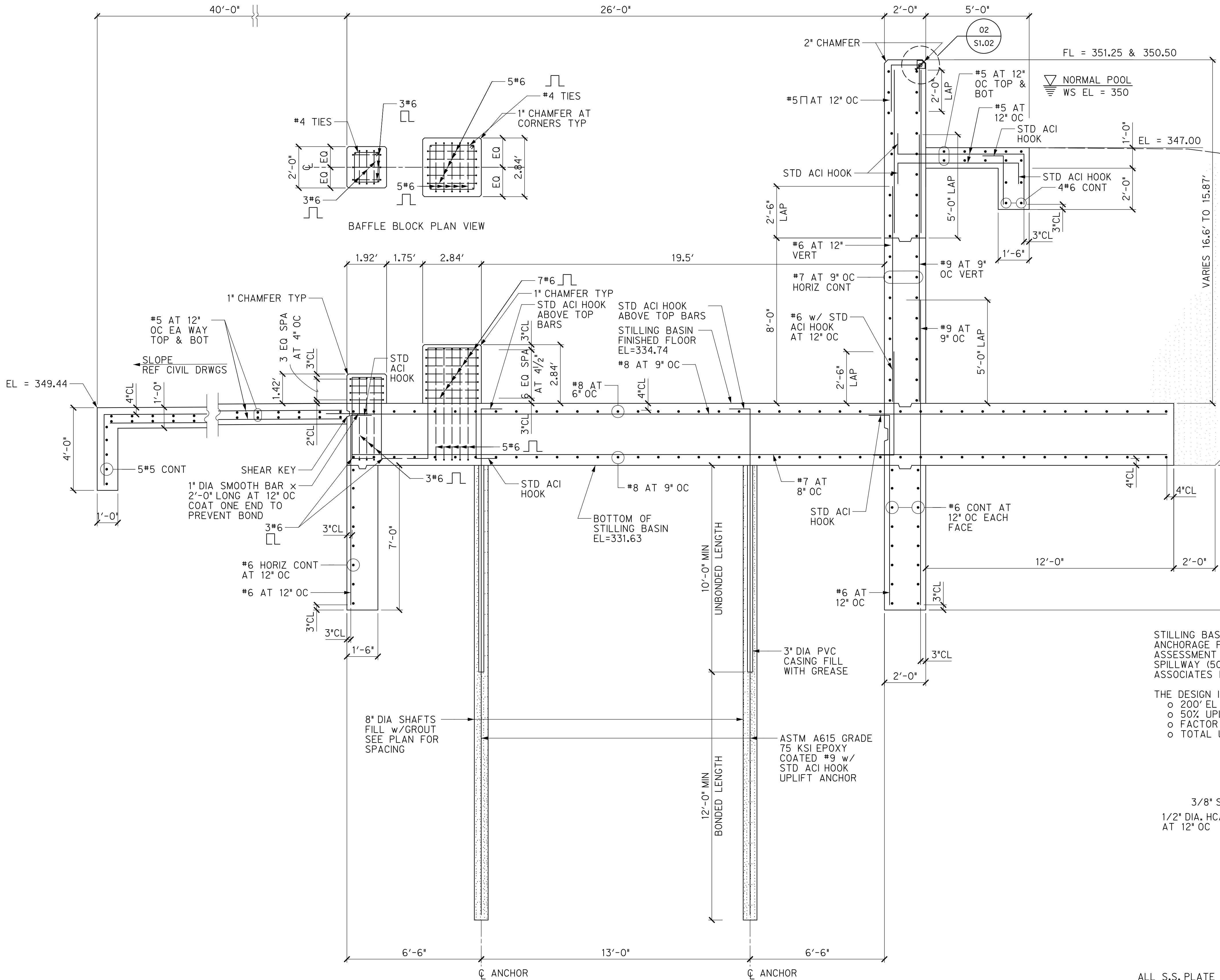
EMBANKMENT TYPICAL SECTION & TOE DRAIN DETAILS

Sheet Number **C5.01**



3" X 5" BULL ROCK NATIVE STONE	
SIEVE SIZE	% RETAINED
5"	0
4"	0-20
3"	30-60
2"	80-100
1"	90-100
1/2"	95-100

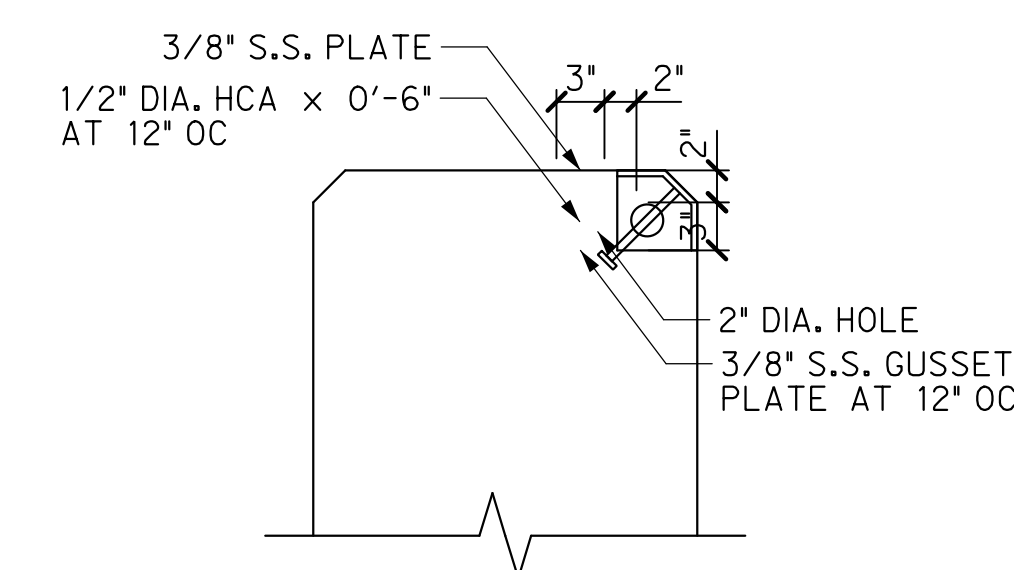




LOW FLOW V-NOTCH WEIR
SCALE = 3/4" = 1'-0"

STILLING BASIN SLAB THICKNESS AND UPLIFT ANCHORAGE FORCES ARE BASED ON HYDRAULIC ASSESSMENT REPORT FOR BUESCHER STATE PARK SPILLWAY (50% DESIGN) PREPARED BY DOUCET AND ASSOCIATES DATED AUGUST 3, 2020.

THE DESIGN IS BASED ON THE FOLLOWING CRITERIA:
o 200' EL 350.50 + EL 351.25 WEIR BASIN SLAB
o 50% UPLIFT
o FACTOR OF SAFETY = 1.10
o TOTAL UPLIFT FORCE = 199,485 LBS



ALL S.S. PLATE TO BE ASTM A240 TYPE 304 TYP.

01
S102
STILLING BASIN AND SHARP CRESTED WEIR SECTION
SCALE = 1/8" = 1'-0"
REF CIVIL DRWGS FOR UNDERDRAIN SYSTEM

02
S102
SPILLWAY CREST ARMOUR SECTION
SCALE = 1" = 1'-0"

TEXAS PARKS AND WILDLIFE
CIVIL ENGINEERING SERVICE
INFRASTRUCTURE AND PLANNING DESIGN
MAILING ADDRESS:
4200 SMITH SCHOOL ROAD
AUSTIN, TX 78744
TEL: (512) 389-4800 FAX: (512) 389-8628

TEXAS
PARKS &
WILDLIFE

HALFF
9500 AMBERGLEN BLVD.
SUITE 100
AUSTIN, TX 78725
TEL (512) 942-6232
FAX (512) 868-0089
TBP&S ENGINEERING FIRM #312

BUESCHER STATE PARK
LAKE DAM IMPROVEMENTS
TPWD# 118686

PRELIMINARY

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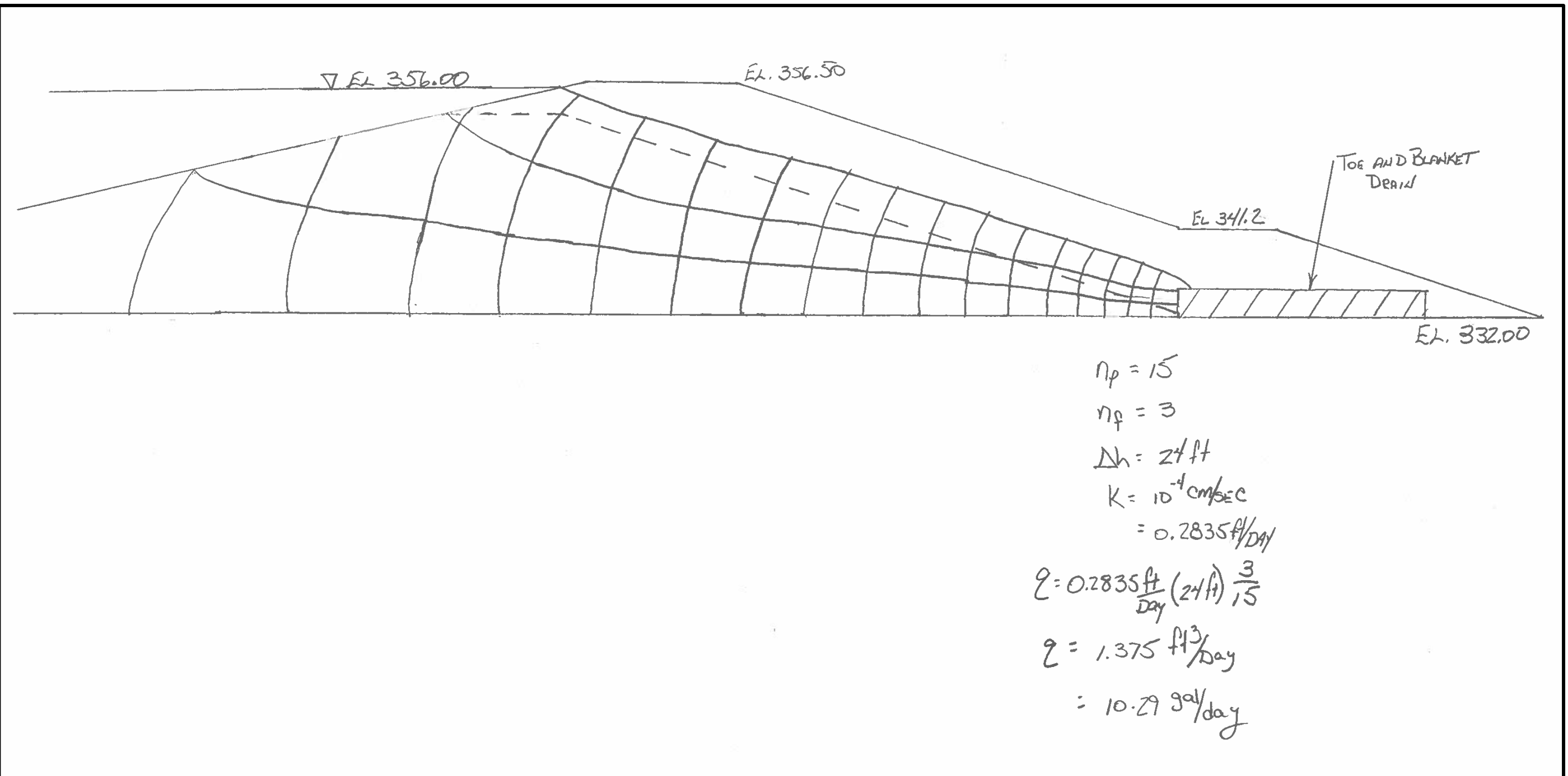
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PAUL J. RIELLY 61307
NAME P.E. NO.
DATE: 11/17/2020

Revision No.	Date	Description

PROJECT NUMBER: 118686
DATE: 11/17/2020
Sheet Title
STILLING BASIN AND SHARP CRESTED WEIR SECTION
Sheet Number
049 of 68
S102

APPENDIX D



FLOW NET

Project Name and Location
Buescher Lake Dam Embankment and Spillway Improvements 100 Park Road 1-C Smithville, Texas

1 inch = 9 feet

Date	PSI Project No.
August 2020	0312-1939

FRAGMENT 1 IS TYPE II

$$S = 4 \text{ FT}$$

$$T = 25 \text{ FT}$$

$$m = \sin\left(\frac{\pi S}{2T}\right) = \sin\left(\frac{\pi(4)}{2(25)}\right) = \sin(0.251) = 0.249$$

$$m^2 = 0.062$$

$$\Phi = \frac{K}{K'} = 0.565$$

FRAGMENT 2 IS TYPE VI

$$S' = 7 \text{ FT} \quad a' = 18 \text{ FT}$$

$$S'' = 4 \text{ FT} \quad a'' = 21 \text{ FT}$$

$$T = 25 \text{ FT} \quad L = 40 \text{ FT}$$

$$L \geq S' + S'' \Rightarrow 40 \geq 7 \text{ FT} + 4 \text{ FT} = 11 \text{ FT} \checkmark$$

$$\Phi = \ln \left[\left(1 + \frac{S'}{a'}\right) \left(1 + \frac{S''}{a''}\right) \right] + \frac{L - (S' + S'')}{T}$$

$$\ln \left[\left(1 + \frac{7}{18}\right) \left(1 + \frac{4}{21}\right) \right] + \frac{40 - (7 + 4)}{25}$$

$$\Phi = 1.663$$

FRAGMENT 3 IS TYPE V

$$S = 7 \text{ FT} \quad a = 18 \text{ FT}$$

$$T = 25 \text{ FT} \quad L = 26 \text{ FT}$$

$$L \geq 2S \Rightarrow 26 \geq 2(7) = 14 \checkmark$$

$$\Phi = 2 \ln \left(1 + \frac{S}{a}\right) + \frac{L - 2S}{T}$$

$$\Phi = 2 \ln \left(1 + \frac{7}{18}\right) + \frac{26 - 2(7)}{25}$$

$$\Phi = 1.137$$

Project Name:

BIESCHER DAM AND
SPILLWAY IMPROVEMENTS

PSI Project No.: D32-F39

intertek
psi

FRAGMENT 4/ IS TYPE 3

$$b = 12$$

$$S = 7$$

$$m = \cos \frac{\pi S}{2T} \sqrt{\tanh^2 \frac{\pi b}{2T} + \tan^2 \frac{\pi S}{2T}}$$

$$m = \cos \frac{\pi(7)}{2(25)} \sqrt{\tanh^2 \frac{\pi(12)}{2(25)} + \tan^2 \frac{\pi(7)}{2(25)}}$$

$$m = \cos 0.440 \sqrt{\tanh^2 0.754 + \tan^2 0.440}$$

$$m = 0.717$$

$$m^2 = 0.514$$

$$\Phi = \frac{K}{K'} = 1.014$$

HEAD AT BASE OF BASIN

$$\text{NORMAL POOL} = 350.00 \text{ FT}$$

$$\text{BASIN ELEV} = 334.54 \text{ FT}$$

$$H = 350.00 \text{ FT} - 334.54 \text{ FT} = 15.46 \text{ FT}$$

HEAD LOSS ACROSS FRAGMENT 1

$$\frac{(15.46 \text{ FT})(0.565)}{0.565 + 1.663 + 1.137 + 1.014} = \frac{8.735}{4.379} = 1.99 \text{ FT}$$

HEAD LOSS ACROSS FRAGMENT 2

$$\frac{(15.46 \text{ FT})(1.163)}{4.379} = 5.87 \text{ FT}$$

HEAD LOSS ACROSS FRAGMENT 3

$$\frac{(15.46 \text{ FT})(1.137)}{4.379} = 4.01 \text{ FT}$$

HEAD LOSS ACROSS FRAGMENT 4

$$\frac{(15.46 \text{ FT})(1.014)}{4.379} = 3.58 \text{ FT}$$

Project Name:

BROOKER DAM AND
SPILLWAY IMPROVEMENTS

PSI Project No.: 0312-1939

intertek
psi

$$Q = \frac{kAM}{Z\theta}$$

$$Q = \frac{10^4 \frac{\text{cm}}{\text{SEC}} (15.46 \text{ FT})}{4.379}$$

$$10^4 \frac{\text{cm}}{\text{SEC}} = 1.9685 \times 10^4 \frac{\text{FT}}{\text{MIN}}$$

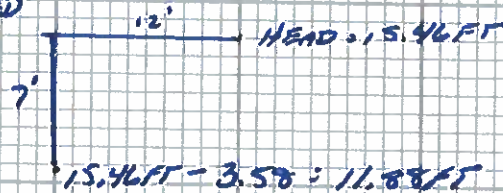
$$Q = \frac{(1.9685 \times 10^4 \frac{\text{FT}}{\text{MIN}}) (15.46 \text{ FT})}{4.379} = 6.95 \times 10^4 \frac{\text{FT}^3}{\text{MIN}}$$

$$Q = 6.95 \times 10^4 \frac{\text{FT}^3}{\text{MIN}} \frac{1440 \text{ MIN}}{\text{DAY}} = 1 \frac{\text{FT}^3}{\text{DAY}}$$

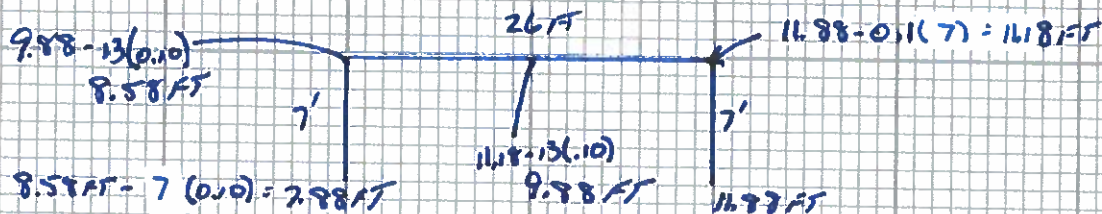
$$Q = 7.48 \frac{\text{GAL}}{\text{DAY}} \text{ PER FT OF SPILLWAY WIDTH}$$

$$Q = 7.48 \frac{\text{GAL}}{\text{DAY}} 200 \text{ FT} = 1496 \frac{\text{GAL}}{\text{DAY}} \text{ TOTAL}$$

FRAGMENT 4 HEAD



FRAGMENT 3 HEAD



$$R = \frac{h}{L+4.5} = \frac{4.01 \text{ FT}}{26+4.5} = 0.10$$

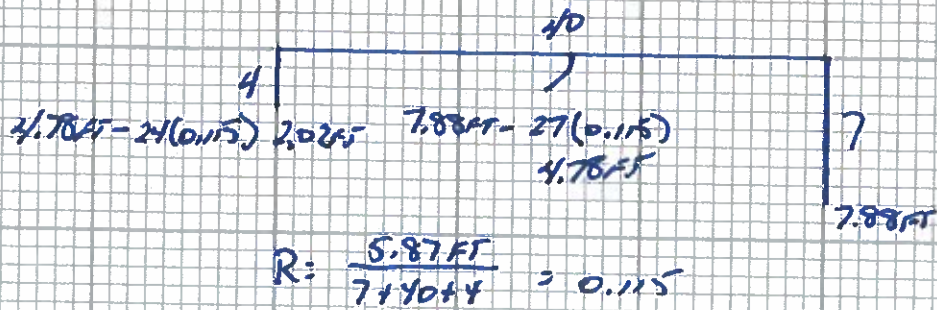
Project Name:

BUESCHER DAM AND
SPILLWAY IMPROVEMENTS

PSI Project No.: 0312-1939

intertek
psi

FRAGMENT Z HEAD



FRAGMENT 1 HEAD LOSS = 199 FT

$$2.02 \text{ FT} \approx 1.98 \text{ FT} \quad \checkmark$$

Project Name:

BUESCHER DAM AND SPILLWAY IMPROVEMENTS

PSI Project No.: 0312-1939

intertek
psi

APPENDIX C

HYDRAULIC REPORT

APPENDIX D

TXDOT RIGHT-OF-WAY ACCESS AGREEMENT



Agreement for Access to
Texas Department of Transportation
Highway Right of Way

Form 2900
(4/20)
Page 1 of 4

STATE OF TEXAS

§

§

COUNTY OF TRAVIS

§

This agreement ("Agreement") is made by and between the Texas Department of Transportation ("TxDOT") and _____, ("Permittee").

RECITALS

- A. Chapter 203 of the Texas Transportation Code empowers the Texas Transportation Commission and TxDOT to lay out, construct, maintain, and operate the state highway system.
- B. Permittee was hired by _____, the owner of property located at _____ in _____, Texas (as shown on Exhibit A) ("Adjacent Property"), to _____ on the Adjacent Property.
- C. Permittee desires to _____ on the Adjacent Property, which _____ will protrude into _____ on TxDOT right of way.
- D. Permittee has requested permission from TxDOT to use the aerial space at least _____ feet above the surface within TxDOT right of way of highway _____ between _____ and _____ Street in the City of _____, _____ County, Texas (as shown on Exhibit B) ("TxDOT Right of Way") for the purpose of _____ within TxDOT Right of Way, which activity is hereinafter referred to as the "Activity."
- E. TxDOT has determined that this use of TxDOT Right of Way is in the public interest and will not damage the highway facility, impair safety, impede maintenance, or in any way restrict the operation of the highway facility;

NOW, THEREFORE, in consideration of the premises and of the mutual covenants and agreements of the parties hereto, to be by them respectively kept and performed as set forth, it is hereby agreed as follows:

AGREEMENT

Article 1. Conducting the Activity

- A. This Activity by Permittee will commence on or after the effective date of this Agreement, and this Agreement will terminate on the earlier to occur of (i) the completion of the Activity or (ii) _____, 20____, unless sooner terminated pursuant to the terms of this Agreement.
- B. The Activity shall conform to a plan of action (attached as Exhibit C) approved by TxDOT prior to entry onto the TxDOT Right of Way and commencement of the Activity by Permittee.
- C. The Activity shall be conducted in compliance with all applicable federal, state, and local laws, regulations, ordinances and policies.
- D. Permittee acknowledges that it enters the TxDOT Right of Way in its "AS IS" condition and that TxDOT has not made and hereby disclaims any representatives or warranties as to the condition of the TxDOT Right of Way.
- E. Permittee will perform the Activity in such a manner as to minimize safety hazards and inconvenience to or interference with highway traffic and assure that there will be appropriate passage allowance for emergency vehicle passage.
- F. If entry onto the pavement in the TxDOT Right of Way becomes necessary, Permittee will notify TxDOT's _____ District Engineer, or designee ("District Engineer"), at least seventy-two (72) hours in advance before closing one or more traffic lanes or otherwise interfering with the flow of traffic in any way. All such lane closures or traffic interference shall comply with a traffic control plan. (Attached as Exhibit D) approved in advance by TxDOT and traffic control devices will be installed by Permittee in accordance with the Texas Manual on Uniform Traffic Control Devices.
- G. At all times when on TxDOT Right of Way, Permittee and its employees, agents, and representatives must wear protective clothing including, but not limited to, protective head gear such as hard hats, protective footwear such as steel-toed shoes, and reflective vests visible to the traveling public.
- H. If during the Activity TxDOT must perform or authorize a contractor to perform routine or special maintenance on the TxDOT Right of Way that conflicts with the Activity, Permittee will suspend the Activity or otherwise cooperate with TxDOT's maintenance requirements.
- I. All equipment or other components of the Activity located in the TxDOT Right of Way must be fire resistant. Operations conducted as part of the Activity which are deemed by TxDOT to be a potential fire hazard will be subject to regulation by TxDOT. The use or storage of flammable, explosive or hazardous materials within the TxDOT Right of Way is prohibited. Permittee, at its sole cost and expense, will take any and all corrective action deemed necessary or desirable by TxDOT and as required by any applicable federal, state, county, or municipal laws, codes, ordinances, rules, regulations to clean up, remove and abate any and all soil contamination, groundwater contamination or any other contamination of the TxDOT Right of Way caused directly or indirectly by Permittee's release or discharge of any hazardous, toxic or otherwise harmful substances in, on, under and around the TxDOT Right of Way. This section will survive termination of the Agreement.
- J. If it becomes necessary for TxDOT to suspend the Activity due to flooding, accident, or other catastrophic event, Permittee will not resume Activity until notified by TxDOT to do so.

Article 2. Concluding Activity

- A. Crane Operator will notify the District Engineer when the Activity has been completed.
- B. Permittee will restore TxDOT's property to its original condition at the conclusion of the Activity. TxDOT shall inspect its property after any such restoration and determine whether the original condition has been restored. If TxDOT determines its property has not been restored to its original condition, TxDOT will repair the property and Permittee will be responsible for the expenses incurred by TxDOT and shall promptly reimburse TxDOT upon written notification. This section shall survive termination of this Agreement.

Article 3. General Terms and Conditions

- A. Prior to commencement of the Activity and before entry onto TxDOT Right of Way, TxDOT must be furnished with proof of insurance from Permittee using TxDOT's Certificate of Insurance, Form 1560, as currently revised (Attached as Exhibit E). The limits of the policy shall remain in effect for the duration of the Activity. TxDOT shall be named as an Additional Insured with a Waiver of Subrogation in favor of TxDOT.
- B. TxDOT's authorization to allow Permittee's use of TxDOT Right of Way as provided herein does not in any way impair or relinquish TxDOT's right to use such property for any purpose, nor shall this Agreement ever be construed as abandonment of the land by TxDOT. It is expressly understood that TxDOT does not purport hereby to grant any real property right, title, interest, easement or other interest in the land described as the TxDOT Right of Way, but merely consents to such use hereunder to the extent that its authority and title permits. Permittee will be responsible for obtaining such additional consents, permits and agreements due to this Agreement.
- C. Permittee will indemnify TxDOT against any and all damages and claims for damages, including those arising from injury to or death of persons or for loss of or damage to property, arising out of, incident to, or in any manner connected with the Activity. This indemnification shall extend to and include any and all court costs, attorney's fees and expenses related to or connected with any claims or suits for damages. Permittee will, if requested in writing by TxDOT to do so, assist with or relieve TxDOT from defending a suit brought against it. This section will survive termination of the Agreement.
- D. Permittee will provide adequate notice of the Activity to all utility owners who are potentially impacted by the Activity.
- E. The erection of signs by Permittee in the TxDOT Right of Way is expressly prohibited without the advance written approval of TxDOT prior to the actual erection.
- F. TxDOT and Permittee each agree and acknowledge that it is not an agent, employee, partner or joint venturer of the other party and that under this provision each party is responsible for its own acts and, and to the extent provided by law, those of its agents, independent contractors and employees. Such responsibility includes, but is not limited to, any claims or amounts arising or recovered under the "Workers Compensation Law," the Texas Tort Claims Act, Chapter 101, Texas Civil Practice and Remedies Code, and any other applicable laws or regulations, all as time to time may be amended.
- G. TxDOT does not intend to waive, relinquish, limit or condition its general governmental immunity from liability in any way. Nothing in this Agreement will be construed as creating any liability in favor of any third party against TxDOT. Additionally, this Agreement will not ever be construed as relieving any third party from any liability against TxDOT.
- H. The State of Texas ("State") may conduct an audit or investigation of any aspect of this Agreement. Permittee must provide the State with access to any information which the State considers relevant to the investigation or audit.

- I. All notices required under this Agreement must be mailed (certified, return receipt requested), hand delivered or sent by overnight courier, with delivery deemed on the earlier of receipt or three (3) days after deposit if sent by mail. Addresses for notice are set forth below the signature blocks below for TxDOT and Permittee.
- J. TxDOT may terminate this agreement at any time upon notifying the Permittee in writing at least thirty (30) days in advance of the intended termination. Notwithstanding the foregoing, TxDOT may terminate this agreement immediately upon a breach of this Agreement by the Permittee or upon TxDOT's determination that the safety of the roadway or traveling public is at risk.

List of Attached Exhibits:

- Exhibit A: Description of Adjacent Property
- Exhibit B: TxDOT Right of Way Location
- Exhibit C: Plan of Action
- Exhibit D: Traffic Control Plan (as necessary)
- Exhibit E: Certificate of Insurance (Form 1560)

IN WITNESS WHEREOF, TxDOT and Permittee have executed duplicate counterparts to effectuate this Agreement. This Agreement will become effective on the date of the last signature.

THE TEXAS DEPARTMENT OF TRANSPORTATION

Executed by the District Engineer of the _____ District for the purpose and effect of activating and/or carrying out the orders, established policies, or work programs heretofore approved and authorized by the Texas Transportation Commission.

By _____, P.E. Date _____

District Address: _____

PERMITTEE

By _____ Date _____

Printed name and title

Address: _____



CERTIFICATE OF INSURANCE

Form 1560
(Rev. 8/18)
Previous editions of this form may not be used.
Page 1 of 2

Agents should complete this form by providing all requested information, then either email, fax, or mail this form as noted at the bottom of page two. Copies of endorsements listed below are not required as attachments to this certificate.

This certificate is issued as a matter of information only and confers no rights upon the certificate holder. This certificate does not confer any rights or obligations other than the rights and obligations conveyed by the policies referenced on this certificate. The terms of the policies referenced in this certificate control over the terms of the certificate.

Insured: _____

Street/Mailing Address: _____

City/State/Zip: _____

Phone Number: () - _____

WORKERS' COMPENSATION INSURANCE COVERAGE:

Endorsed with a Waiver of Subrogation in favor of TxDOT.

Carrier Name:			Carrier Phone #: () -	
Address:			City, State, Zip:	
Type of Insurance	Policy Number	Effective Date	Expiration Date	Limits of Liability:
Workers' Compensation				Not Less Than: Statutory - Texas

COMMERCIAL GENERAL LIABILITY INSURANCE:

Carrier Name:			Carrier Phone #: () -	
Address:			City, State, Zip:	
Type of Insurance:	Policy Number:	Effective Date:	Expiration Date:	Limits of Liability:
Commercial General Liability Insurance				Not Less Than: \$ 600,000 each occurrence

BUSINESS AUTOMOBILE POLICY:

Carrier Name:			Carrier Phone #: () -	
Address:			City, State, Zip:	
Type of Insurance:	Policy Number:	Effective Date:	Expiration Date:	Limits of Liability:
Business Automobile Policy				Not Less Than: \$ 600,000 combined single limit

UMBRELLA POLICY (if applicable):

Carrier Name:			Carrier Phone #: () -	
Address:			City, State, Zip:	
Type of Insurance:	Policy Number:	Effective Date:	Expiration Date:	Limits of Liability:
Umbrella Policy				

Should any of the above described policies be cancelled before the expiration date thereof, notice will be delivered in accordance with the policy provisions.

THIS IS TO CERTIFY to the Texas Department of Transportation acting on behalf of the State of Texas that the insurance policies named are in full force and effect. If this form is sent by facsimile machine (fax), the sender adopts the document received by TxDOT as a duplicate original and adopts the signature produced by the receiving fax machine as the sender's original signature.

Agency Name

Address

City, State, Zip Code

() - _____

Authorized Agent's Phone Number

Authorized Agent Original Signature

Date

The Texas Department of Transportation maintains the information collected through this form. With few exceptions, you are entitled on request to be informed about the information that we collect about you. Under §§552.021 and 552.023 of the Texas Government Code, you also are entitled to receive and review the information. Under §559.004 of the Government Code, you are also entitled to have us correct information about you that is incorrect.

NOTES TO AGENTS:

Agents must provide all requested information then either email, fax, or mail this form as noted below.

Pre-printed limits are the minimum required; if higher limits are provided by the policy, enter the higher limit amount on an Acord Form.

To avoid work suspension, an updated insurance form must reach the address listed below one business day prior to the expiration date. Insurance must be in force in order to perform any work.

Binder numbers are not acceptable for policy numbers.

The certificate of insurance, once on file with the department, is adequate for subsequent department contracts provided adequate coverage is still in effect. Do not refer to specific projects/contracts on this form.

List the contractor's legal company name, including the DBA (doing business as) name as the insured. If a staff leasing service is providing insurance to the contractor/client company, list the staff leasing service as the insured and show the contractor/client company in parenthesis.

The Texas Department of Insurance (TDI) approved forms are the only acceptable proof of insurance for department contracts. The preferred Certificate of Insurance (COI) is on a 1560 or Acord form.

Over-stamping and/or over-typing entries on the certificate of insurance are not acceptable if such entries change the provisions of the certificate in any manner.

DO NOT COMPLETE THIS FORM UNLESS THE WORKERS' COMPENSATION POLICY IS ENDORSED WITH A WAIVER OF SUBROGATION IN FAVOR OF TXDOT.

The **SIGNATURE** of the agent is required.

CERTIFICATE OF INSURANCE REQUIREMENTS:

WORKERS' COMPENSATION INSURANCE:

The contractor is required to have Workers' Compensation Insurance if the contractor has any employees including relatives.

The word STATUTORY, under limits of liability, means that the insurer would pay benefits allowed under the Texas Workers' Compensation Law.

GROUP HEALTH or ACCIDENT INSURANCE is not an acceptable substitute for Workers' Compensation.

COMMERCIAL GENERAL LIABILITY INSURANCE:

MANUFACTURERS' or CONTRACTOR LIABILITY INSURANCE is not an acceptable substitute for Comprehensive General Liability Insurance or Commercial General Liability Insurance.

BUSINESS AUTOMOBILE POLICY:

If coverages are specified separately, they must be at least these amounts:

Bodily Injury	\$500,000 each occurrence
	\$100,000 each occurrence
Property Damage	\$100,000 for aggregate

PRIVATE AUTOMOBILE LIABILITY INSURANCE is not an acceptable substitute for a Business Automobile Policy.

Completed forms may be submitted by any of the following methods:

Email: CST_Insurance@txdot.gov
Fax: (512) 416-2536
Mail: Texas Department of Transportation
CST – Contract Processing
125 E. 11th Street
Austin, TX 78701-2483

APPENDIX E

PERMITS